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July 15, 1985

Energy Research Abstracts

Abstracts 23379-25090

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription (use PB85-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic (North America) or $28.00 for foreign (outside North America); a single issue is $8.00 or $16.00, respectively.

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB85-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $40.00 for domestic subscribers and $80.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers; a single issue is $7.00 and $14.00, respectively.

***Current Energy Patents (CEP)*–PB85-902800**

Devoted to international patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB85-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB85-914600**

Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB85-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB85-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $40.00 for domestic (North America) and $80.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB85-901000**

Covers all aspects of acid precipitation, including effects and possible control measures.

***Buildings Energy Conservation (BEC)*–PB85-900700**

Covers worldwide information on the technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB85-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB85-900800**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB85-946600**

Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB85-900600**

Covers worldwide information on all aspects of biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB85-914700**

Covers information on the exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*– PB85-900500**

Covers all aspects of heavy-ion (A > 4) reactions.

***Laser Research (LAR)*–PB85-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB85-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

***Nuclear Reactor Safety (NRS)*–PB85-913500**

Covers the safety aspects of accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB85-902900**

Covers the management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB85-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB85-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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NOTICE

The 1984 Annual Indexes of *Energy Research Abstracts* (Volume 9) are available on microfiche. The five indexes may be ordered separately or as a set via the following codes and order numbers.

Index	Code	Price	Order No.
1. Corporate Author	A01	$4.50	DE85012278
2. Contract Number	A01	$4.50	DE85012279
3. Report Number and File No. Correlation	E01	$6.50	DE85012280
4. Personal Author	E01	$6.50	DE85012281
5. Subject	E03	$9.50	DE85012282
6. Set (all 5 indexes)	E10	$23.50	DE85012283

DOE offices and contractors may order from the DOE Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; others should order from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

AND

Printed copies of the indexes are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. The price of the set is $83.00, and the sales stock number is S/N 061-000-00657-5.

energinfo ERA

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00657-5 and the price is $83.00 for the Vol. 9 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

Office of Scientific and Technical Information
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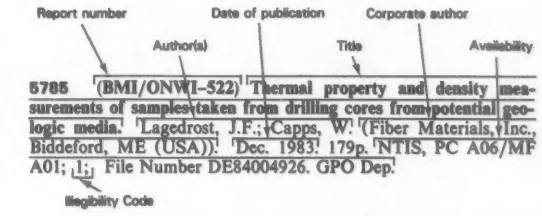
HOW TO USE *ENERGY RESEARCH ABSTRACTS*

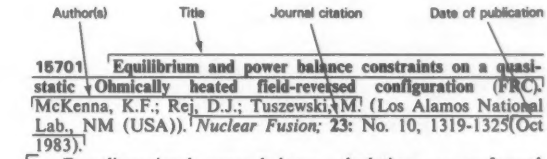
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.

Abstract: Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract: Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522 9:5785 **NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70**

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Much of the information is provided by (1) bilateral exchange agreements with foreign organizations, and (2) exchange agreements or contracts with other U. S. government agencies, private firms, or institutions.

Foreign Sources

CEA Centre d'Etudes de Saclay
GIF-sur Yvette Cedex, France

Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
Technical Information Service
London, England

International Atomic Energy Agency
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Vienna, Austria

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Risoe National Library
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Oak Ridge, TN

National Aeronautics and Space Administration
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Springfield, VA

National Institutes of Health
National Library of Medicine
Bethesda, MD

Plenum Publishing Corporation
New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 39 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semi-monthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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REFER ALSO TO CITATION(S) 23409, 23410, 23413, 23460, 23593, 23806, 23939, 24169

23379 (CONF-8206274—, pp 2-7) **Diagnostics in fossil-fuel conversion and utilization.** Penner, S.S. (Univ. of California, San Diego). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

The studies performed by the DOE Fossil Energy Research Working Group (FERWG) have repeatedly led to identification of needs for improved diagnostics and instrumentation to assure adequate process control and monitoring and to allow model verification and development. A significant dichotomy remains between techniques that can be applied successfully in coal gasification, coal liquefaction, and industrial coal combustion processes. Following an introduction and survey of advanced measurement techniques (Section 1), we present brief summaries of identified needs for instrumentation relating to coal gasification (Section 2) and coal liquefaction (Section 3). We conclude with comments on practical difficulties involved in the utilization of particulate sizing with laser scattering techniques (Section 4). 8 references.

23380 **(DOE/ER/10096—T15) Hydrogenation of coal and coal-derived intermediates.** Rao, M.G. (Howard Univ., Washington, DC (USA). Dept. of Chemical Engineering). [1985]. Contract FG05-78ER10096. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011087.

The main objective of the present study is to hydrogenate coal and processed coals such as SRC under less severe conditions of temperature and pressure. Experimental conditions chosen were the least severe possible, temperatures in the range of 375°F to 440°F and a hydrogen partial pressure of 25 psia. Even at H_2 partial pressures as low as 1 atm and temperatures around 390°F, zinc chloride salt melts proved to be effective in further depolymerizing and hydrocracking solvent refined coals. However, in the absence of strong hydrogen donor solvents, there is a tendency for polynuclear fragments to repolymerize. When solvent refined coals were treated in a reaction mixture of coal:$ZnCl_2$:Tetralin in the ratio of 1:4:3, considerable portion of the asphaltenes were converted into oil fraction, in addition to desulfurization. This is a significant upgrading of the SRC. Under the very mild experimental conditions used in the present study, zinc chloride melts fortified by tetralin showed little extent of liquefaction of bituminous coals (Kentucky No. 12). However, when hydroquinone also was added (Coal:$ZnCl_2$:Tetralin: Hydroquinone = 1:4:3:1), to reaction mass, coal was converted to a product very similar to solvent refined coal (SRC). In the present study, a massive chemical attack was mounted to achieve similar liquefaction results as obtained under massive temperature and pressure attack. If the unconverted chemicals could be recycled, there is no reason why a process based on the present approach cannot be economically viable. 4 tables.

23381 **(DOE/ET/10069—T112) EDS coal liquefaction process development: Phase V interim report. EDS hybrid boiler development program. Volume II. Pilot scale combustion testing of EDS bottoms derived from three different rank coals.** (Exxon Research and Engineering Co., Florham Park, NJ (USA)). [1985]. Contract FC05-77ET10069. 246p. (FE—2893-133). NTIS (US Sales Only), PC A11/MF A01; 1; GPO Dep. File Number DE85007014.

This is an interim technical progress report for US Department of Energy Cooperative Agreement No. FC05-77ET10069, EDS Coal Liquefaction Process Development - Phase V. Funding is shared by US Department of Energy, Exxon Company, USA (a division of Exxon Corporation), Electric Power Research Institute, Japan Coal Liquefaction Development Company, Phillips Coal Company, Anaconda Minerals Company, Ruhrkohle A.G., and ENI. This agreement covers the period January 1, 1977 through December 31, 1985. This interim report documents work carried out by Combustion Engineering, Inc. under a contract to Exxon Research and Engineering Company and was prepared by Combustion Engineering, Inc. This volume is the second of four by Combustion Engineering, Inc. on the development phase of the Hybrid Boiler program. It documents results from the following principle tasks: (1) bench-scale characterization of EDS residues and their ash samples; (2) combustion evaluation of EDS residues and their chars in the Drop Tube Furnace System (DTFS); (3) EDS pulverization testing in C-E's bowl mill; (4) ash deposition evaluation in the pilot scale Fireside Performance Test Facility (FPTF); and (5) carbon loss prediction from the EDS residues in the proposed hybrid boilers. 13 references, 77 figures, 49 tables.

23382 **(DOE/ET/10069—T113) EDS coal liquefaction process development, Phase V. EDS consolidation program: reactor optimization design study.** (Exxon Research and Engineering Co., Annandale, NJ (USA)). Mar 1985. Contract FC05-77ET10069. 36p. (FE—2893-152). NTIS (US Sales Only), PC A03/MF A01; 1; GPO Dep. File Number DE85010394.

This is an Interim Report prepared under the US Department of Energy Cooperative Agreement No. FC05-77ET10069 for EDS Coal Liquefaction Process Development - Phase V. Funding for the EDS Project is shared by US Department of Energy, Exxon Company, USA (a division of Exxon Corporation), Electric Power Research Institute, Japan Coal Liquefaction Development Company, Phillips Coal Company, Anaconda Minerals Company, Ruhrkohle AG, and ENI. The agreement covers the period January 1, 1977 through December 31, 1985. The laboratory process research and development studies were conducted at various Exxon Research and Engineering (ER and E) facilities: Research and Development Division at Baytown, Texas; Products Research Division at Linden, New Jersey; and the Exxon Research and Development Laboratories at Baton Rouge, Louisiana. The engineering research and development studies were performed by the Exxon Engineering Petroleum and Synthetic Fuels and Technology Departments at Florham Park, New Jersey. This report documents the results of a reactor optimization design study. The work was conducted as part of the EDS Consolidation Program. The design recommendations represent a consolidation of learnings accrued during previous phases of the EDS Project including results obtained from ECLP operations, from the ECLP Test Program, and from past EDS Study Design preparations. 2 references, 7 figures, 6 tables.

23383 **(DOE/ET/10679—T36) RCEE Engineering Program. Quarterly report, January 1-March 31, 1985.** (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). Apr 1985. Contract AC22-77ET10679. 23p. (FE—2468-115). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010379.

The name of the ESCOE program has been changed to the RCEE since it is now supported only by the AIChE. They work for DOE headquarters and report in particular on data analysis of the ITSL coal liquefaction process, on the feasibility and economics of 3 chemical coal preparation processes (TRW Gravimelt process, GE microwave process, and JPL chlorinolysis process), and the recommendations for a petrography facility for PETC. (LTN)

23384 (DOE/FE/60181—139) Extraction of a North Dakota lignite with supercritical aliphatic solvents. Swanson, M.L.; Dollimore, J.; Olson, E.S.; Diehl, J.W. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Apr 1985. Contract FC21-83FE60181. 11p. (CONF-850942—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009963.

From 190. American Chemical Society national meeting; Chicago, IL, USA (8 Sep 1985).

Figure 5 suggests that the supercritical fluid solvents used were extracting more of the compounds that would devolatilize below ~400°C with increased operating temperature necessary with the longer solvent chain length. The analyses of the extracts revealed the presence of aliphatic esters, alcohols, acids and alkanes with litle or no aromatics being extracted. Separations and quantitative infrared spectroscopy have been performed on the chloroform-methanol soluble fractions (~50 wt %) from the supercritical pentane and hexane extractions. The yields from this preliminary data averaged 0.19%, 0.06%, and 0.26% for the waxy esters, aliphatic alcohols and the fatty acids, respectively. Proton NMR showed that the aromatic content of the extracts tended to increase slightly with increasing operating temperature. Capillary GC analyses on whole samples and silica gel column separated samples using a 15 m SE-54 column provided data on the distribution of normal and cyclic alkanes, waxy esters, and fatty alcohols and acids. The series of n-alkanes occurred between C_{21} and C_{33} with a maximum concentration of the C_{29} alkane. A number of triterpanes and C_{15} to C_{20} cyclic alkanes were present. The fatty alcohols were found to be mainly C_{24}. The fatty acids were converted to their methyl esters for analysis. A series of esters was observed with maximum concentration at C_{24} and C_{26}. From the composition and yield data, it appears that extraction of Indian Head lignite with supercritical aliphatic solvents with critical temperatures below 325°C still has the characteristics of nonspecific extraction. 10 references, 5 figures, 5 tables.

23385 (DOE/LC/11010—1772) Overburden characterization and post-burn study of the Hanna IV, underground coal gasification site, Wyoming, and comparison to other Wyoming UCG sites. Marcouiller, B.A.; Burns, L.K.; Ethridge, F.G. (Colorado State Univ., Fort Collins (USA)). Nov 1984. Contract AS20-83LC11010. 284p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85003381.

Analysis of 21 post-burn cores taken from the Hanna IV UCG site allows 96 m (315 ft) of overburden to be subdivided into four local stratigraphic units. The 7.6 m (25 ft) thick Hanna No. 1 coal seam is overlain by a laterally discontinuous, 3.3 m (11 ft) thick shaley mudstone (Unit A') in part of the Hanna IV site. A more widespread, 30 m (90 ft) thick well-indurated sandstone (Unit A) overlies the A' unit. Unit A is the roof rock for both of the Hanna IV cavities. Overlying Unit A is a 33 m (108 ft) thick sequence of mudstone and claystone (Unit B), and the uppermost unit at the Hanna IV site (Unit C) is a coarse-grained sandstone that ranges in thickness from 40 to 67 m (131 to 220 ft). Two elliptical cavities were formed during the two phases of the Hanna IV experiment. The larger cavity, Hanna IVa, is 45 x 15 m in plan and has a maximum height of 18 m (59 ft) from the base of the coal seam to the top of the cavity; the Hanna IVb cavity is 40 x 15 m in plan and has a maximum height of 11 m (36 ft) from the base of the coal seam to the top of the cavity. Geotechnical tests indicated that the Hanna IV overburden rocks were moderately strong to strong, based on the empirical classification of Broch and Franklin (1972), and a positive, linear correlation exists between rock strength and volume percent calcite cement. There is an inverse linear correlation between rock strength and porosity for the Hanna IV overburden rocks. 28 refs., 34 figs., 13 tabs..

23386 (DOE/MC/19122—1810) Advanced development of a pressurized ash agglomerating fluidized-bed coal gasification system. Environmental, health, and safety studies associated with the technology development program, FY 1982. (Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.). 23 Jun 1983. Contract AC21-82MC19122. 265p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85010517.

Westinghouse Electric Corporation is engaged in the development of a pressurized, fluidized-bed gasification process at its Waltz Mill Site in Madison, Pennsylvania. With the sponsorship of the Department of Energy, its precursor agencies, and the Gas Research Institute, Westinghouse has conducted this development from 1975 to March 1980 under Contract EF-77-C-01-1514, from March 1980 to January 1982 under contract AC21-80-ET14752, and from January 1982 to May 1983 under Contract AC21-82MC19122. The overall objective of the program is to demonstrate the viability of the Westinghouse process for the environmentally acceptable production of low- and medium-Btu fuel gas from a variety of fossilized carbonaceous feedstocks for electrical power generation, synthetic natural gas, chemical feedstocks, and industrial fuels. This report presents the results of environmental, health and safety studies conducted during the technology development to 1982. Relatively few environmental studies were conducted from 1975 to 1980, with the exception of solid wastes, since technology development was the primary impetus. Similarly the health and safety studies performed were primarily to ensure a safe working environment. During the 1980 to 1982 period, however, work was specifically initiated to expand the environmental data base supporting Westinghouse gasification technology and to continue health and safety work. The results, with their implications, are contained herein. 23 figs., 114 tabs.

23387 (DOE/MC/19122—1811) Advanced development of a pressurized ash agglomerating fluidized-bed coal gasification system. Phase I final report, January 16, 1982-April 30, 1983. (Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.). 1 Aug 1983. Contract AC21-82MC19122. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85011063.

Westinghouse Electric Corporation is engaged in the development of a pressurized, fluidized-bed, gasification process at its Waltz Mill Site in Madison, Pennsylvania. With the sponsorship of the Department of Energy, its precursor agencies, and the Gas Research Institute, Westinghouse has conducted this development from 1975 to March 1980 under Contract EF-77-C-01-1514, from March 1980 to January 1982 under Contract AC21-80-ET14752, and from January 1982 to April 1983 under Contract AC21-82MC19122. The overall objective of the program is to demonstrate the viability of the Westinghouse process for the environmentally acceptable production of low- and medium-Btu fuel gas from a variety of fossilized, carbonaceous feedstocks for electrical power generation, substitute natural gas, chemical feedstocks, and industrial fuels. This final report covers Phase I of the contract period (January 16, 1982 to April 30, 1983) and is a continuation of the work performed in 1980 and 1981 and reported in the 1982 final report, FE-14752-28. Included is work performed in fiscal 1982-1983 on PDU testing, process analysis, cold flow scaleup facility, process and component engineering and design, and laboratory support studies. 2 refs., 18 figs., 14 tabs.

23388 (DOE/MC/19163—1789) Great Plains ASPEN model development: steam generation and distribution. Final topical report. Schwint, K.J. (Scientific Design Co., Inc., New York (USA)). Feb 1985. Contract AC21-82MC19163. 773p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85003392.

Two ASPEN models were developed for the Steam Generation and Distribution, Area 5000/5100, of the Great Plains Gasification Plant: a complete flowsheet simulation model, and a rigorous model for the simulation of the steam boilers and steam superheaters. The complete flowsheet model can be run by specifying either the heat and power requirements or the steam flowrates for all the steam consumers in the plant. The flowsheet model will give the material and energy balances for a given set of process conditions, and is used best for simulating the steam system at or near design conditions. This model cannot be used for rating because it is lacking fired heater, heat exchanger, and turbine rating models. The results of several case study runs that were made using each model were as expected. The flowsheet model showed a decrease in steam production as the plant load was decreased. The rigorous steam boiler and superheater model showed higher NO/sub x/ concentrations as the excess air was increased and lower NO/sub x/ concentrations as the equilibrium combustion temperature was decreased. It is not practical to integrate the steam generation and distribution flowsheet model with the individual plant section flow-

sheet models because of the large amount of computer storage and long running time that would be required. 1 reference, 4 figures, 16 tables.

23389 **(DOE/MC/19163—1790) Great Plains ASPEN model development: gasifier quench, gas cooling, shift conversion, gas liquor separation sections. Final topical report.** Stern, S.S.; Kirman, J.J.; Rinard, I.H. (Scientific Design Co., Inc., New York (USA)). Feb 1985. Contract AC21-82MC19163. 454p. NTIS, PC A20/MF A01; GPO Dep. File Number DE85003393.

A single ASPEN model has been developed that encompasses the Gasifier Quench (Section 1100), Gas Cooling (Section 1300), Shift Conversion (Section 1200), and Gas Liquor Separation (Section 1800). This model is based on the process descriptions given in Sections 6.7, 6.8, 6.9 and 6.13 of the Great Plains Project Management Plan and Lummus Schematic Process Flow Diagrams, Dwg. No. SK-7102-201A-2, SK-7102-1D-2, SK-7102-1D-2, and SK-7102-1H-2. The model is primarily a flowsheet simulation that will calculate the material and energy balances and equipment duties for a given set of process conditions. The model is unable to predict fully changes in process conditions that would result from load changes on equipment of fixed sizes, such as a rating model would. The model can be used to simulate the steady-state operation of the plant at or near design conditions, or to design other similar processes. The model also can be used in optimization studies on operating conditions, particularly in the shift conversion area. Because of the limited amount of process information that was available, several major process assumptions had to be made in the development of the flowsheet model. The model developed is robust and no convergence problems were encountered. Varied in the case studies were the temperature approach to equilibrium in the shift reactor and the quantity of gas being shifted. The results are as expected, the lower the equilibrium approach temperature and the more gas being sent to the shift reactor, the lower the carbon monoxide-to-hydrogen ratio obtained. The converse is true for higher approach temperatures and less gas being shifted. 55 references, 5 figures, 9 tables.

23390 **(DOE/MC/19350—1760) Applications of fluidics for coal conversion/utilization processes.** Mon, G. (Harry Diamond Labs., Adelphi, MD (USA)). Oct 1984. Contract AI21-82MC19350. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85003372.

Fluidics is a technology that provides sensing, amplifying and controlling functions with fluid power through the interaction of a fluid stream with other fluid streams or with a sensing object without using mechanical moving parts. Previous applications of fluidics differ from many of the sensing and controlling needs for coal conversion/utilization processes in that none of the previous systems has to sense multiphase fluids containing solid particles and/or vapors. Such particles and/or vapors can alter or completely block the critical dimensioned flow passages in the fluidic circuits. For fluidics technology to be successfully applied to coal conversion/utilization processes, interfacing design concepts for sensing and power fluidics techniques need to be identified and developed. After making an extensive literature survey, we have identified a number of sensing and controlling functions that can be advantageously implemented by using fluidic technology. We have also presented the basic design and methods of implementation. It appears that fluidic technology can be used to sense pressure, temperature, flow rates, and level for coal conversion/utilization processes. Fluidic technology can also be used to divert and throttle flow process streams. Particle separation devices can be designed with wall-attachment-type fluidic elements. One can also cool electronic and acoustic instrumentation with a fluidic vortex tube. 25 refs., 27 figs.

23391 **(DOE/OR/21400—T111) Alkali attack of coal gasifier refractory linings. Progress report No. 1, February 1-March 31, 1985.** Brown, J.J.; Farkas, D. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Materials Engineering). 15 Apr 1985. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010127.

VPI 4.8.

The computer program SOLGASMIX-PV is being used to calculate the thermodynamically stable phases and chemical reactions that will occur among refractory linings in the presence of alkali impurities. The first step in this task is to conduct an extensive literature search for available thermodynamic data on the possible compounds to be formed among the reacting species. During the present reporting period this search was partially completed and a first series of preliminary calculations was completed. A large amount of thermodynamic data were compiled from various sources regarding the possible phases to be formed in the presence of sodium compounds and vapor. The data base for Na now includes a total of 57 phases. This compilation appears to be very complete for low temperatures (from room temperature to 627°C). At high temperatures, data are scarce. In particular, data are not available as a function of temperature, but only for a few points beyond 627°C. This means that the high temperature calculations will require the use of extrapolated data. 6 refs., 4 tabs.

23392 **(DOE/PC/70002—T1) Coal liquefaction co-processing. Quarterly report No. 1, 1 September-31 December 1984.** (UOP, Inc., Des Plaines, IL (USA). Process Div.). 21 Jan 1985. Contract AC22-84PC70002. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010145.

Progress made in each of the following tasks is described for the first quarter: (1) project management plan; (2) feedstock analysis; and (3) base testing condition development. The project management plan described the UOP co-processing program on a subtask-by-subtask basis and included a description of the analytical schedule for the feedstock analyses (Task 2.0) the test planned for the reactivity screening (Task 3.0) and for the continuous bench-scale operations (Task 4.0), and finally the proposed program for determining the cost estimate of a commercial facility (Task 5.0). The objective of Task 2.0 was to procure and analyze the feedstocks necessary for work in Task 3.0. Work on this task has taken longer than anticipated because of difficulties in obtaining the coal and some resid feedstocks. It is expected that this task will be completed by the first part of February. Work on subtask 3.1 (base testing condition development) was scheduled to start during this quarter, but due to delays in feedstock procurement, was also delayed and testing was not started until January 3, 1985. However, it is anticipated at this time that no changes in the overall programs schedule will be necessary.

23393 **(DOE/PC/70787—T1) Supercritical water based liquefaction. Quarterly report No. 2, December 15, 1984-March 14, 1985.** Stenberg, V.I. (North Dakota Univ., Grand Forks (USA)). 1985. Contract FG22-84PC70787. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008656.

In 1984, we began using H_2O-H_2S as a substitute for organic, hydrogen-donor pasting solvents for coal liquefaction. The philosophy for its use is that the water fulfills the role of the slurrying liquid and H_2S is the hydrogen atom donor. The data of Table 1 compare the H_2O-H_2S results along with those using (1) a petroleum-coal based organic solvent, anthracene oil (A04) together with a solvent refined coal middle distillate from the demonstration plant at Tacoma, Washington (SRCMD) and (2) dihydrophenanthrene (DHP), a reputedly excellent hydrogen donor solvent. Water with synthesis gas equal the performance of A04-SRCMD with synthesis gas for the conversion of two coal samples into volatile materials at the conditions used. The presence of a small amount of H_2S enhances the as-defined yields whether in water or in an organic solvent. The reactions which had the temperature programmed from 300°C to 500°C using H_2O-H_2S and synthesis gas gave the best of the aqueous-H_2S conversion yields. Synthesis gas is superior to pure H_2 (980 psig). The dihydrophenanthrene (DHP) runs gave better conversions than either water or A04-SRCMD given otherwise the same experimental conditions. However, DHP decomposes to the extent of 11% at 420°C at 30 minutes, and the non-gaseous products are solids rather than liquids as they are with the water runs. The water runs were the easiest to separate from the product slurry. The distillation was complete in approx. 3 hours with the water runs whereas it took from 5 to 7 hours to get to constant weight with the organic solvent-based runs. The oil separated by gravity from the water in the water based run distillates. 11 refs., 1 tab.

23394 **(EUR—9407-EN) Development and application of the ARACHNE package to predict the efficiency and cost of processes to convert coal into synthetic fuels.** Holmes, J.; Ford, N.; Goldthorpe, S.; Weston, B.; Bogle, A.; Davison, J.E.; Merrick, D.; Syrett, W.P. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. vp. Commission of the European Communities, Luxembourg.

A new version of the ARACHNE package (version 5) has been written and tested. Version 5 extends the capabilities of ARACHNE to simulate coal conversion processes based on direct hydrogenation of coal, in addition to processes based on combustion and gasification. The new version also significantly improves the ease and flexibility of use of the package. The package has been tested successfully by modelling the main processing stages of the NCB's liquid solvent extraction process. A capital costing package, IDMON, has been developed as a companion to ARACHNE. The package consists of a capital cost data base, generated mainly from US studies, and a set of functions for the generation of capital cost estimates from this data base. The level of detail considered for cost estimation is that generally described as 'study estimate'. The process is broken down into its main processing steps which are costed as units. Balance of plant items, contingency etc. are then costed as add-on percentages. Twelve coal conversion processes based on coal gasification have been studied. Processes for the production of hydrogen, methanol, ammonia and gasoline from each of Texaco, Shell and BGC/Lurgi gasifiers have been simulated using ARACHNE and costed using IDMON.

23395 **(SAND—85-0101) Underground Coal Gasification Program: FY84 annual report.** Tyner, C.E. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 91p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85010416.

As part of the Department of Energy's Underground Coal Gasification research program, activities at Sandia National Laboratories during FY84 have included cornering water jet drill development, subsidence and cavity growth modeling in support of the Tono PSC field experiments, field testing of the CSAMT remote monitoring technique, and laboratory experimentation and site characterization planning in support of the Eastern bituminous UCG program. Accompliahments for the year include completion of the cornering water jet drill program, including a field proof-of-concept demonstration; comparisons of cavity growth and subsidence model calculations with results of the Tono field experiments, demonstrating the ability of these models to predict cavity/overburden interactions affecting the gasification process; remote CSAMT monitoring of the Tono field experiment and demonstration of the ability of the technique to detect process effects remotely and in real time; development and testing of a laboratory gasification system to investigate early cavity growth and other phenomena in swelling Eastern bituminous coals; and detailed site characterization planning for the upcoming Eastern UCG field program. 40 references.

23396 **(STEV-TORV—84-12) Project vacuum dryer.** Leufstedt, H.E. (Statens Energiverk, Stockholm (Sweden)). Jun 1984. 20p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751442.

Tests of a recently designed vacuum dryer for peat are reported. Problems with dust being transported with the water vapor to the condenser have been overcome. The capacity of the dryer is about 2 m^3/h and the water content was reduced from 66-71 percent to 26-32 percent in the test runs.

23397 **(TNO-HMT-R—84-76) Isolating fly ash adsorbed benz(a)anthracene-14C and benzo(a)pyrene-14C using liquid extraction.** Besemer, A.C.; Lems, T. (Nijverheidsorganisatie TNO, Delft (Netherlands)). May 1984. 16p. (In Dutch). Nijverheidsorganisatie TNO, Delft, Netherlands.

Results are presented of a research program to the properties of fly ash with regard to the adsorption and desorption of polycyclic hydrocarbons. Benz(a)anthracene (with four rings) is adsorbed less than benzo(a)pyrene (with five rings). The composition of fly ash is also important. Results indicate that as the carbon content of the fly ash increases the adsorption increases too. The desorption behavior, using with good results toluene and xylene, was investigated. The desorption of PAH is better with lower carbon content of the fly ash. (J.C.R.)

23398 **New micro motion mass flow meters.** Agarwal, A.K.; Turgeon, M. (Monsanto Co., Dayton, OH). *Energy Progress;* **4**: No. 4, 221-224(Dec 1984). Contract AC04-76DP00053.

A detailed case-history study of the application of special mass flow meters in coal-liquefaction facilities is presented.

23399 **Diesel fuels from minimally processed coal pyrolysis liquids -- Exploratory investigations.** Graves, R.L.; Fox, E.C. (Oak Ridge National Laboratory). *Proceedings, Intersociety Energy Conversion Engineering Conference;* **2**: 1219-1225(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

Experiments and studies of low-temperature coal pyrolysis were performed with emphasis on the quality of the raw coal liquids instead of on the yield. Raw product quality was emphasized because the cost of upgrading increases rapidly with the amount of high-boiling-point materials and contaminants. The hydrogen/carbon ratio of the raw product was higher and the aromaticity lower than in many upgraded coal-derived distillates. Combustion of blends of the oils with diesel fuel in diesel engines was feasible. Studies suggest that if the combination of oil yield and quality found in the laboratory experiments is maintained in a scaled-up process, the economics would then be favorable.

23400 **Theoretical and experimental considerations of the SRC-I solidification process.** Moujaes, S.F. (International Coal Refining Company, Allentown, PA). *Proceedings, Intersociety Energy Conversion Engineering Conference;* **2**: 1258-1265(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

Solidification is an important heat transfer process in the SRC-I Demonstration Plant Baseline Design which handles about one-third of the liquid products throughput. This amounts to about 42,000 kg/hr where the rest are fed to the coker/ calciner and ebulated bed hydrotreater. Batchwise (Rexnord) and waterbath solidification technologies are under consideration for the Baseline design of the 6,000 TPD Demonstration Plant. In order to better understand the effect of the different parameters involved in both technologies, two computer simulation models using transient heat conduction have been developed. Experimental data, concerning slab temperatures, have been obtained using an infrared technique to evaluate the Rexnord technology. The computer simulation results have been compared to the available data and the results show that the model simulates reasonably well the transient thermal behavior of the slab. The deviation is about 5% and 20%, between experimental and theoretical results, for the average of the temperature profile and local temperature values respectively. It was found that in the case of the Rexnord simulation the thickness of the slab, the thermophysical properties of the product and the solidification temperature could play an important role in the cooling process. The simulation of the waterbath solidification process is found to be a faster cooling process than the Rexnord process due to the higher heat transfer coefficients involved and the higher ratio of surface area to volume used in the waterbath technology.

23401 **Role of instrumentation in UCG process development.** Hommert, P.J. (Sandia National Lab., Albuquerque, NM). *AIChE (American Institute of Chemical Engineers) Symposium Series;* **79**: 77-88(1983).

The different types of instrumentation used in monitoring underground coal gasification field tests exhibited varying capabilities in tracking the growth of the reaction cavity. The types tried included thermocouples, electromagnetic methods, and acoustic techniques. A review of their advantages and limitations concludes that thermometry, high-frequency electromagnetic methods, and perhaps a surface electromagnetic technqiue should be developed for future tests.

23402 Review of underground coal gasification field experiments at Hoe Creek. Thorsness, C.B.; Creighton, J.R. (Lawrence Livermore National Lab., CA). *AIChE (American Institute of Chemical Engineers) Symposium Series;* 79: 15-43(1983).

In three underground coal gasification experiments at the Hoe Creek site near Gillette, WY, LLNL applied three different linking methods: explosive fracture, reverse burning, and directional drilling. Air was injected in all three experiments; a steam/oxygen mixture, during 2 days of the second and most of the third experiment. Comparison of results show that the type of linking method did not influence gas quality. The heat of combustion of the product gas was higher with steam/oxygen injection, mainly because of reduced inert diluent. Gas quality was generally independent of other operating parameters but declined from its initial value over a period of time because of heat loss to the wet overburden and extensive roof collapse in the second and third experiments.

23403 Hanna, Wyoming underground coal gasification field test series. Bartke, T.C.; Gunn, R.D. (Laramie Energy Technology Center, WY). *AIChE (American Institute of Chemical Engineers) Symposium Series;* 79: 4-14(1983).

The six in situ coal gasification field tests conducted by LETC near Hanna, WY, demonstrated typical gasification rates of 100 tons/day for continuous operation of about 30 days. Featuring high coal recovery and high product-gas calorific values, the underground process proved to be simple, reliable, and potentially controllable.

23404 Ground water effects of underground coal gasification experiments in northeastern Wyoming. Ganow, H.C.; Mead, S.W.; Stone, R.; Stuermer, D.H.; Wang, F.T. *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* No. SPE-8449, vp(1979). (CONF-790913—).

From 54. annual SPE technical conference and exhibition; Las Vegas, NV, USA (23 Sep 1979).

The Lawrence Livermore Laboratory has conducted 2 underground coal gasification experiments at its Hoe Creek Site in NE Wyoming. Environmental studies in conjunction with these experiments, including an investigation of changes in local groundwater quality were conducted. Such changes are a consequence of the residual reaction products - coal ash, char, some of the coal tars, and roughly 10% of the product gases - which remain underground after gasification. When ground water returns to the gasification zone, leaching and dissolution processes lead to the formation of a plume of contaminated ground water, which begins to move through the coal seam. In addition, fissuring and roof collapse may destroy the integrity of the underground reaction vessel permitting contaminants to escape to the surface or into overlying aquifers. The field program is augmented by laboratory measurements and modeling studies. 10 references.

0105 By-products

23405 (VTT-TUTK—284) Production of activated carbon from peat. A techno-economic feasibility study. Sipilae, K.; Asplund, D.; Ekman, E. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). May 1984. 99p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751472.

The production of activated carbon from peat was studied both with laboratory and pilot plant experiments in a fluidized-bed furnace. Peat coke was mainly used as raw material, and it was gasified partially with steam to granular activated carbon. The activated carbon grades produced were evaluated on the basis of physical characteristics, for example, volume weight, hardness, specific surface, and pore structure. The proximated analysis of activated carbon crush produced from peat coke: volume weight 220-260 g/l, specific surface 700-1100 msup/g, ash content 13-15%. The physical properties of the produced activated carbon grades were equal to those of commercial carbon brands. On the basis of these trial runs, an activated carbon plant for capacities of 400 t/a and 1500 t/a was preliminary designed adn the use of the fluidized-bed furnace for regenerating activated carbon was evaluated. The initial investment in the production plant was estimated to amount to FIM 3.5 mill. and FIM 5.9 mill. The refund periods of the basic alternatives would be 26 and 2 years, and the minimum capacity of profitable production 900 t/a.

0106 Properties

REFER ALSO TO CITATION(S) 23386, 23460, 24153

23406 (CONF-850530—2) Viscosity prediction of highly concentrated polymodal coal-water slurries. Probstein, R.F.; Sengun, M.Z. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). 1985. Contract FG22-84PC70061. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010608.

From 7. international symposium on coal slurry fuels preparation and utilization; New Orleans, LA, USA (21 May 1985).

In the present paper a preliminary semi-empirical method is developed to predict the rheological properties of high concentration, plymodal coal-water slurries at low shear rates. The results presented represent work still in progress. The basis of the analysis is to consider a polydisperse pulverized coal slurry as made up of two relatively distinct particle fractions - a coarse fraction and a smaller fine fraction. The particles in the fine fraction are of micron size and are assumed to behave as a colloidal suspension in the carrier liquid. The coarse fraction takes up much of the space and its hydrodynamics with respect to the suspension are assumed to be the same as if it were in a pure liquid with the same viscous behavior as the suspension. The theory is first applied to truly bimodal high concentration suspensions of two different size spherical particles. It is shown that at low shear rates the viscosity of these slurries can be accurately matched to viscosities calculated on purely geometric arguments, which had previously been found to agree well with experiment. A semi-empirical analytical model based on this bimodal concept, which employs results from the simpler truly bimodal case, is applied to six high concentration polymodal coal-water slurries with continuous particle size distributions ranging from about 1 to 300 microns. The results are found to support the idea that these slurries can be treated as bimodal. 6 refs., 1 fig., 4 tabs.

23407 (DOE/ER/10275—1C, pp 1, Paper 41) Determination of sulfur content in coal by infrared spectroscopy. Wood, R.T.; Hill, K.L.; Muhlheim, M.D.; Weber, B.J. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

A system for the immediate determination of the sulfur content by weight of coal incoming to a fossil-fired steam plant is proposed. The system removes 100 lbs. from the coal carrier using a standard penetration device. The sample is crushed and riffled to yield a 3-lb base sample. The moisture content of the sample is determined using microwave drying and the sulfur content of the sample is ascertained using spectroscopic analysis of the sample's combustion gases. These values are combined to give the pounds of sulfur per pound of dry coal. The acquisition and analysis of the coal sample requires 120 seconds to complete. The value of the percent sulfur by weight in dry (waterless) coal given by the system is accurate to within 1.0% of the sulfur content. The system's precision is 0.01% by weight. The initial cost of the system (components, materials, and fabrication) is $160,600 and the levelized annual cost of the system (including personnel and maintenance costs) is $103,403.

23408 (DOE/ER/60215—1) Separation of non-volatile components of fossil fuels at very high resolution and their structural characterization. Progress report, May 1, 1984-April 30, 1985. Novotny, M.V. (Indiana Univ., Bloomington (USA). Dept. of Chemistry). 1985. Contract FG02-84ER60215. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010162.

Current research has primarily focused on the means to resolve effectively complex mixtures of heterocyclics. Various microcolumns were investigated, but the reversed-phase systems which utilize C_8- and C_{18}-bonded materials (3 or 5 μm particle size) were

found most effective. An example of such optimized separations is shown in the attached Figure 1, which displays the sulfur-containing fraction of a coal liquid. The microcolumn used exhibited 240,000 theoretical plates, allowing an effective resolution and a subsequent mass-spectral investigation. Nitrogen-containing polycyclics and phenolics have also been separated and we are currently in the process of elucidating their structures through mass-spectral investigations. As our first attempt to expand the identification capabilities, in association with microcolumn liquid chromatography, we have designed and tested a photodiode array-based detector that is capable of the acquisition of total fluorescence spectra from chromatographic peaks. The system shows adequate spectral resolution at a low-picogram detection limit (using a conventional light source), and no sacrifice of chromatographic resolution. We have shown on a "model separation" of coal tar constituents that both total fluorescence and selective profiles can be acquired in addition to spectral subtraction capabilities. 4 references, 1 figure.

23409 (DOE/PC/50790—T7) Role of preasphaltenes in coal conversion reactions. Final report. Hill, G.R.; Meuzelaar, H.L.C.; Futrell, J.H.; Harper, A.M.; McClennen, W.H. (Utah Univ., Salt Lake City (USA). Biomaterials Profiling Center). Dec 1984. Contract FG22-82PC50790. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85007808.

The experiments performed during this period have produced new data on the pyrolysis behavior of HVB Hiawatha coals in general and on the influence of weathering processes and the role of preasphaltenes in particular. Some of the most important findings are: (1) Whereas, short contact time (SCT) tubing bomb reactor conversion yields at 425°C are more than halved in coal weathered at 100°C for 212 hours, indicating that most of the new bonds formed in weathered coal remain intact under these conditions, estimated Py-MS vacuum pyrolysis yields at 610°C show a relatively minor reduction only (50%→40%), suggesting that most weathering-induced bonds are broken again. (2) Our data provide further support for the binary phase coal model proposed by Given and others. In freshly mined HVAB Hiawatha coals the ratio between mobile phase and network phase components appears to be ~ 1:2. (3) At moderate temperatures (425°C) most preasphaltene type molecules produced during SCT pyrolysis experiments may well be produced by thermal extraction of mobile phase components rather than by pyrolytic processes. At higher temperatures, however (≧ 600°C), an increasingly large fraction of the preasphaltene-type products appears to be derived from the network phase. (4) Under vacuum micropyrolysis conditions the presence or absence of mobile phase components (here defined as pyridine-extractable components) does not seem to have a major effect on the pyrolysis mechanisms of the network phase (here defined as non-pyridine-extractable residue). (5) Our findings demonstrate that preasphaltene yields are strongly dependent on the weathering status of a coal. In fact, stuctural changes induced by weathering are so extensive and complex that the weathering status of a coal may be expected to have a measurable influence on every type of thermal conversion technology. 14 refs., 11 figs.

23410 (DOE/PC/70774—T2) Characterization of Alaskan coals: evaluation of their liquefaction behavior. Quarterly technical progress report, November 1984-January 1985. Youtcheff, J.S.; Rao, P.D. (Alaska Univ., Fairbanks (USA). Mineral Industry Research Lab.). 1985. Contract FG22-84PC70774. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008703.

Accomplishments during this past quarter included characterization of the coals in the sample set and the running of liquefaction experiments using tetralin as a donor solvent. Analyses conducted included: ultimate and proximate analyses, calorific value determinations, vitrinite reflectance measurements and maceral composition evaluation. Preliminary results from the liquefaction runs indicate that the subbituminous C coals from the Beluga and Nenana coal fields are more readily converted to THF soluble products than the higher rank coals from the Matanuska and Northern Alaska coal fields. 2 refs., 4 tabs.

23411 (DOE/PC/70782—3) Electron spin mapping of coal molecular structure by ENDOR. Quarterly technical progress report. Belford, R.L. (Illinois Univ., Urbana (USA)). 15 Apr 1985. Contract FG22-84PC70782. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011097.

During this three month period, work has advanced in several areas, notably the observation of first ENDOR spectra from whole coals, the development of a model system study and first ENDOR spectra from this system, and the completion of the preparative vacuum system. Each of these topics are discussed. 2 figures.

23412 (EUR—9473-EN) Certification of the contents of arsenic, cadmium, chromium, cobalt, fluorine, manganese, mercury, nickel, lead and zinc in a coal. Gonska, H.; Griepink, B.; Colombo, A.; Muntau, H. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 65p. Commission of the European Communities, Luxembourg.

The report describes the preparation of a coal reference material for trace analysis as well as the tests carried out to establish the stability and homogeneity of the material. The analyses were carried out by several methods selected for producing the most accurate results and were performed by several laboratories experienced in coal analyses and in trace element analysis. The results are reproduced in detail and discussed. The report also explains the methodology followed to assign the uncertainties to the respective certified values.

23413 (NP—4901627) Characterisation of solid residues from coal liquefaction processes. Final report. (Regina Univ., Saskatchewan (Canada)). Jun 1983. 144p. NTIS (US Sales Only), PC A07/MF A01. File Number DE84901627.

Coal feedstocks and solid products from coal liquefaction and coal-bitumen coprocessing experiments conducted by four Canmet-sponsored research groups are studied using petrographic methods supplemented by trace element data obtained by SEM-EDS. Maceral analyses and reflectance data are used to assess the petrographic compositions and ranks of the coal feedstocks. The contents of reactor samples, solid products and distillation residues from various coal liquefaction processes are classified according to the optical characters of the microscopical components. The origins of the residue components are identified petrographically and by trace element studies of petrographically selected components. 20 references, 9 figures.

0108 Waste Management

REFER ALSO TO CITATION(S) 23386, 23397, 23749, 23753, 23754, 23755, 23756, 23758, 23759, 23760, 23761, 23762, 23763, 23764, 23765, 23766, 23767, 23768, 23769, 24472

23414 (CONF-8503103—1) Control of acid deposition precursors through dry scrubbing. Farber, P.S. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010281.

From 2. international conference on acid rain; Washington, DC, USA (26 Mar 1985).

The use of a dry scrubbing method developed at Argonne National Laboratory is discussed. The discussion includes a description of the process, high-sulfur-coal applications, process economics and characterization of wastes. The process uses high calcium pebble lime as the sorbent and electrostatic precipitators for particulate matter collection. 7 figs., 6 tabs.

23415 (DOE/ET/17093—1741) Testing and verification of granular filters for removal of particulate and alkalies. Final report. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Apr 1984. Contract AC21-80ET17093. 590p. NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE85007168.

This report describes the testing and evaluation of a shallow bed granular filter (GBF) concept for Pressurized, Fluidized Bed

Combustion (PFBC) application. The GBF is a device on which the dustladen gas passes through a shallow bed of granular media, depositing the particulate matter on the surface of the bed forming a dust cake. The bed media is cleaned by a reverse flush that gently fluidizes the bed and elutriates the collected particulate matter from the system. A 500 acfm subpilot scale GBF was built and tested at simulated PFBC operating conditions. Two different GBF configurations have been evaluated accounting for over 220 hours of testing (cumulative) and 615 cleaning cycles. Test variables have included bed media, filter flow face velocity, backflush conditions and dust loading. In addition to the subpilot scale test work, a modified single bed, bench scale GBF unit was evaluated as an improved design approach for PFBC conditions. Results of this work showed that the overall performance of the GBF can be improved if the system can be cleaned without fluidizing the bed media. This has resulted in redefining backflush conditions and the choice of bed media. The possibility of utilizing the GBF to remove both particulate and alkali has also been explored. Implementing an alkali gettering media as part of the GBF bed media would be possible but would require significantly deeper beds than anticipated in the current shallow bed, GBF concept. 27 references, 135 figures, 40 tables.

23416 **(DOE/MC/21147—T1) Solid waste sampling and distribution. Quarterly technical progress report, January-March 1985.** Page, G.C. (Radian Corp., Austin, TX (USA)). 1985. Contract AC21-84MC21147. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008562.

EPA has yet to issue a final classification for conventional coal combustion wastes; for the present, under a statement issued by EPA, the wastes remain exempted from hazardous regulations. Wastes generated by advanced energy-related processes being developed by the Department of Energy have not yet been subjected to close scrutiny. Yet, it is critical that any potential, waste-related constraints be identified as soon as possible, so that timely corrective action can be undertaken and so that more informed decisions concerning process development can be made. This "Sampling and Distribution Project" constitutes the lead activity of a new DOE effort to investigate these wastes. This project includes acquisition of samples and distribution of those samples to laboratories where they will be characterized. This quarterly report summarizes activites accomplished during the period January-March 1985.

23417 **(EPRI-CS—3936) Coal-Waste Artificial Reef Program. Final report.** (New York State Energy Research and Development Authority, Albany (USA)). Mar 1985. 127p. NTIS, PC A07/MF A01 - Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303; GPO Dep. File Number DE85010837.

The Coal Waste Artificial Reef Program (C-WARP) has investigated the environmental effects of disposing of fly ash and scrubber sludge in the ocean in the form of stabilized blocks. An artificial reef was constructed in the Atlantic Ocean with 500 tons of coal waste blocks on 12 September 1980. This report summarizes the studies made from March 1979 through August 1983. The effort included laboratory and field studies to (1) measure physical block properties; (2) examine mineral phases; (3) determine the blocks' chemical changes in seawater; (4) analyze leachate characteristics; and (5) collect environmental monitoring data on the reef. Separate analytics have been done on individual sections of the report and are contained in EDB. 48 figs., 14 tabs.

23418 **(EPRI-CS—3952) Site evaluation of failure data sheets for flue gas desulfurization components. Final report.** Newman, J.T. (Bechtel Group, Inc., San Francisco, CA (USA)). Apr 1985. 85p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920592.

The primary objective of this study was to test a methodology previously developed for EPRI for collection, monitoring, and reporting of FGD component failures. The testing was undertaken at two host sites. The purpose was to determine how accessible the information would be, and how much of a burden data reporting would be on station personnel. A computerized data base was developed for organizing the obtained data and generating summary statistics on FGD reliability. The major conclusions drawn from this study are: (1) a data base management system integrated with analytical software provides an effective means of input, storage, retrieval, and comparative analysis of FGD component failure data; (2) a data collection methodology similar to that tested is understandable and can be effectively followed by power plant personnel but requires dedicated support and enthusiasm at all levels in the plant; and (3) the methodology is unable to account for discretionary, preventive and elective maintenance, thereby limiting its data gathering capability and usefulness. 2 figs., 5 tabs.

23419 **(KHM-TR—48) Technical properties of waste products from coal combustion. A laboratory study.** Moeller, B.; Nilsson, G. (Statens Vattenfallsverk, Vaellingby (Sweden). Projekt KOL-HAELSA-MILJOE). May 1983. 135p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE85751417.

This report is the result of a laboratory study of technical properties of some waste products from different kinds of coal combustion processes and flue gas desulfurization. The investigations have comprised chemical analyses, microstructure, general technical parameters, compaction properties, strenght and strain properties and permeability. The wastes are derived from combustion of coal of different origin. The main compounds of the fly ashes are SiO_2, Al_2O_3 and Fe_2O_3. The chemical analyses of bottom ash show appproximately the same contents and amounts as that of fly ashes. The waste from the wet-dry FDG-process contains about 40% lime, 40% fly ash and 7% sulphur. The main chemical compounds in wet FDG-products are calcium sulphite (appr. 45%) and calcium sulphate (appr 30%). The fly ash from pulverized coal combustion mainly consists of grains with spherical forms and the fly ash from grate firing mainly consists of grains with irregular shape, often porous. Bottom ash is a material with irregular grain structure, often aggregated. The wet dry fdg-products consists of small, porous particles made up to aggregates moulded to fluffy forms. Pulverized coal fly ash and wet dry desulfurization products have a compression strenght of more than 1000 kPa, while fly ash from grate firing only has a compression strenght in the interval of 50-100 kPa. The permeability coefficients of fly ashes and wet-dry desulfurization products are very much affected of the compaction degree.

23420 **(KHM-TR—84) Leaching of waste products from coal combustion. A literature survey.** Liem, H.; Rydevik, U.; Moberg, P.O. (Statens Vattenfallsverk, Vaellingby (Sweden). Projekt KOL-HAELSA-MILJOE). Jun 1983. 124p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85751419.

Leaching studies at the laboratory scale should, be carried out in the form of shaking tests. Column tests are time consuming and difficult to reproduce. Usually, one uses for leaching experiment, a 20 weight % ash and continuous shaking during 24 hours. For the determination of the maximum concentration in the leachate respectively the maximum leachability for a component, one uses repeated shaking experiments with replacement of solid phase for the same liquid phase, respectively, replacement of liquid phase for the same solid phase between the shaking cycles. The leach solution usually of distilled water, or acidic solution with pH around 4. Normally, less than 2-3 weight % of the substances from coal ash are dissolved in water and the main part of the leachable metals come from the surface layer of the coal ash. Coal ash contains less than 0.2 ppm PAH (poly aromatic hydrocarbon) and a leachate from flyash 2-4 ppb POM (polycyclic organic material). A model is proposed for the calculation of the time needed for the neutralization of the basic substances of a given ash deposit by a certain type of rain. Computer calculations have also been made for the analysis of the phase equilibria, which control the ionic composition of the leachate. Absorption and coprecipitation of trace metals with iron, manganese and aluminium oxide and hydroxide probably affect the concentrations of the trace elements in the leachate. In the literature the use of mass spectroscopy and NAA are recommended as surveying techniques of trace elements analysis. For the analysis of low concentrations, the use of AAS with graphite is recommended (KAE).

23421 (MRP/MSL—83-10) Evaluation of a rapid test for available alkali determination in fly ashes. Winer, A.A.; Malhotra, V.M. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Jan 1983. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901630.

A rapid method for available alkali in fly ash has been evaluated. Fourteen samples of fly ash, obtained from producers of fly ash in Canada have been subjected to both the ASTM Standard test and the rapid methods. The procedure for the rapid method is simple and can be completed within 30 minutes compared to 28 days for the ASTM procedure. A statistical analysis shows that a highly significant correlation exists between the two methods and the precision of the rapid method is at least as good as the ASTM method. When results from all previous correlation investigations for the ASTM versus rapid methods are combined with those from the present investigation, the regression line obtained is highly significant at the 99% level. The correlation coefficient is 0.97. In preliminary testing for sodium and potassium in the filtrate leached from fly ash by sulphuric acid interference from sulphate is found to be negligible. 4 references, 3 figures, 5 tables.

23422 (TVA/PE/FHP—85/4) Current status of flue gas purification within TVA. Thompson, J.T. (Tennessee Valley Authority, Chattanooga (USA). Div. of Fossil and Hydro Power). 1985. 17p. (CONF-850168—1). NTIS, PC A02/MF A01. File Number DE85901206.

From Colloquium on firing technology and environmental protection; Cologne, F.R. Germany (24 Jan 1985).

This paper describes the Tennessee Valley Authority's (TVA) experience with flue gas purification equipment on coal-fired power plants. TVA's experience encompasses mechanical collectors, electrostatic precipitators, baghouses, wet limestone scrubbers, and atmospheric fluidized bed combustion (AFBC). Air pollution control at TVA facilities originally consisted of mechanical fly ash collectors which were installed primarily for equipment protection. Following a Presidential Executive Order and subsequent passage of the Clean Air Act, TVA's air pollution control measures for particulates and SO_2 increased dramatically. The addition of precipitators, baghouses, SO_2 scrubbers, and use of low-sulfur coal and coal-washing plants has significantly reduced emissions from TVA's coal-fired plants. Since 1977, TVA has achieved reductions of approximately 93% in particulate emissions and 50% in sulfur dioxide emissions. TVA is currently pursuing two new promising technologies for utility flue gas pollution control through a 160-MW AFBC demonstration project and a 160-MW dry flue gas desulfurization (FGD) project. 2 figs., 2 tabs.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 23386, 23404, 23753, 24293

23423 (USGS/WRI—82-4099) Preliminary appraisal of the hydrology of the Stigler area, Haskell County, Oklahoma. Marcher, M.V.; Huntzinger, T.L.; Stoner, J.D.; Blumer, S.P. (Geological Survey, Oklahoma City, OK (USA). Water Resources Div.). 1983. 69p. US Geological Survey, Box 25425, Federal Center, Denver, CO 80225. File Number TI85901273.

Bedrock in the Stigler area of southeastern Oklahoma consists principally of shale, siltstone, and sandstone of the McAlester, Savanna, and Boggy Formations of Pennsylvanian age. These rocks have been folded to form the Stigler syncline on the north and the Antioch anticline on the south. An area of several square miles is underlain by terrace deposits, mostly sandy silt, as much as 25 ft thick. Alluvium along the streams is 5 to 10 ft thick and consists mainly of sandy silt. Neither the terrace deposits nor the alluvium are hydrologically significant. Water in the bedrock is under artesian conditions. Well depths range from 34 to 235 ft and average 95 ft. The water level in most wells is less than 30 ft below the land surface. Based on specific-conductance measurements, dissolved-solids concentrations in ground water are estimated to range from 200 to 2500 milligrams/liter. Streams in the area are ephemeral and extended periods of no flow can be expected. Streamflow in Taloka Creek was maintained by water pumped from an active coal mine. Water upstream from the mine area had a mean dissolved-solids concentration of 72 milligrams/liter whereas water downstream from the mine area had a mean concentration of 1323 milligrams/liter. Samples of water collected from Taloka Creek since mining ceased did not have excessive concentrations of toxic metals. Maximum suspended-sediment discharge of Taloka Creek was about 1660 tons/day. Silt-clay particles (dia less than 0.062 mm) were the dominant grain size. Observed or measured effects of surface mining for coal on the hydrologic system include (1) creation of additional water storage in the surface mine pond, (2) disruption of drainage in an area of about 1 square mile, (3) increased mineralization of water in Taloka Creek, (4) changes in permeability and storage of water in mine spoil, (5) minor changes in streamflow and runoff characteristics, and (6) temporary increase in the sediment load of Taloka Creek.

0110 Reserves And Exploration

23424 (ERP/CRL—83-16(R)) Discussion paper: the application of geostatistics to the Sydney Coalfield. Aston, T.R.C.; MacNeil, D.; White, C. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Aug 1983. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901632.

To assess whether geostatistical techniques can be applied to the problems and conditions existing in the Sydney Coalfield, a three day visit was made to the Mine Evaluation Group (MEG), MRL Ottawa, by CBCRL personnel. As a test case, data from the NOVACO Point Aconi open pit site was input to the Mine Evaluation Group's GEM (Geostatistical Evaluation of Mines) suite of programmes. This report describes the sequence of operations performed on the Point Aconi data when using the GEM system programmes. Examples of semi-variogram analysis and kriging are given, although a detailed evaluation of the site was not possible due to a lack of time. Finally, the direction of future research programmes regarding the use of geostatistics in the Sydney Coalfield are discussed. In particular, it is suggested that a dual purpose programme be established to undertake both the resource/reserve evaluation of mineral areas and the use of geostatistics in the field of strata mechanics. 30 refs., 5 figs.

23425 (NP—5901293) Estimation of uncertainty in coal resources. Tewalt, S.J.; Bauer, M.A.; Mathew, D.; Roberts, M.P.; Ayers, W.B. Jr.; Barnes, J.W.; Kaiser, W.R. (Texas Univ., Austin (USA). Bureau of Economic Geology; Texas Energy and Natural Resources Advisory Council, Austin (USA)). 1983. 145p. NTIS, PC A07/MF A01. File Number DE85901293.

This report identifies sources of uncertainty in coal resource estimation. Classical statistical methods show that the minimum number of evenly distributed boreholes required to characterize resources of a lignite seam to within a precision of 20 percent is substantially less than might be expected intuitively and depends on the coefficient of variation of seam thickness. Geostatistical methods indicate that a substantial further reduction in the minimum number of boreholes is possible when a spatial dependency structure can be established by means of a variogram. Resource figures for seams calculated by manual, computer, and geostatistical methods at various levels of data density are well within those predicted by classical statistical theory. These studies demonstrate that the maximum seam thickness variation occurs at the margins of lignite seams and that variations in thickness of individual lignite seams are not a major source of uncertainty in resource estimation, given the level of data usually available. However, determination of the areal extent and seam boundaries of coal beds is a major source of uncertainty.

23426 (USGS-OFR—79-306) Federal Coal Resource Occurrence and Federal Coal Development Potential maps of the Stigler west quadrangle, Muskogee and Haskell Counties, Oklahoma. Brady, B.T. (Geological Services of Tulsa, Inc., OK (USA); Geological Survey, Denver, CO (USA)). 1983. 149p. US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901274.

The Stigler coal is the only coal found at the surface in the Stigler west quadrangle. Crop lines are found along the southern

edge and in the northwest corner of the quadrangle, and roughly paralleling the Lone Star anticline, (Plate 1). The structure of the Stigler coal is shown on Plate 5, and reflects the influence of the Stigler syncline, with beds dipping gently toward the axis of the syncline. Data on the Stigler coal is for the most part sparse, particularly away from the cropline. Most of the information on the coal used in this report comes from non-proprietary information in USGS files, with additional information from Karvelot (1972) and Oakes and Knechtel (1948). Appendix I gives a complete listing of all sources of data. In general, the data available indicates that the Stigler coal varies from just under 1 foot (0.3 m) to slightly more than 2 feet (0.6m) toward the northeast of the quadrangle. The Stigler coal has been strip mined in the quadrangle, but not very extensively. A summary of the chemical analyses available for the Stigler coal are presented on Table 1. Average analyses are given, as is the range for all samples used to calculate each average value. 25 references.

23427 **(USGS-OFR—81-540) Assessment of hydrologic conditions in potential coal-lease tracts in the Warrior coal field, Alabama.** Puente, C.; Newton, J.G.; Bingham, R.H. (Geological Survey, Tuscaloosa, AL (USA)). 1982. 50p. US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901330.

Assessing the hydrology of potential Federal coal-lease tracts, because of their dissemination and limited data, requires some predictive capability. Four tracts assessed were located in the outcrop of three coal groups and other relatively impermeable rocks in the Pottsville Formation. Physical settings of the tracts and most other areas in the Warrior coal field are similar. This results in similar ground-water and surface-water characteristics, in similar impacts resulting from surface coal mining, and in maximizing the transferability of data. Assessments of the tracts reflected the small storage of water in underlying rocks and corresponding limited yields to wells and to the base flow of streams. Ground water and surface water in undisturbed areas are generally of good quality. Some subbasins in the tracts have already been impacted to some degree of mining. Estimates of streamflow characteristics and the availability and quality of ground water in the tracts were made using available methodology or assessments based on local and regional data. Hydrologic assessments of the tracts, based on limited verification data, proved to be reasonably accurate. Almost all ground-water verification data fall within estimated ranges and the remainder are close. Similarly, almost all surface-water quality data obtained fall within estimated ranges based on variations in discharge, and most of the remainder are close. Impacts that will result from future mining in tracts are defined. Methodology used to estimate future impacts on surface-water quality is described with examples. 9 references.

23428 **(USGS/WRI—82-4009) Hydrology of coal-resource areas in the southern Wasatch Plateau, central Utah.** Danielson, T.W.; Sylla, D.A. (Geological Survey, Salt Lake City, UT (USA). Water Resources Div.). 1983. 108p. US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901339.

The study area includes about 700 square miles of the southern Wasatch Plateau in central Utah and is underlain by extensive reserves. Data for four streamflow-gaging stations in the area indicate that about 5 to 29 percent of the average annual precipitation on a drainage basin becomes streamflow. Annual peak discharge generally is from snowmelt during spring or early summer; 46 to 68 percent of the average annual discharge occurs during April-June. Discharge measurements indicate that most of the base flow of streams is due to ground-water discharge in the higher altitudes of the watersheds. Chemical quality of 61 surface-water samples was suitable for most uses; dissolved-solids concentrations ranged from 97 to 835 milligrams per liter. None of the analyzed chemical constituents were in concentrations that exceeded the drinking-water standards of the US Environmental Protection Agency. The predominant dissolved ions in most of the surface waters were calcium, magnesium, and bicarbonate. About 170 springs were inventoried during the study. Most water moves through the ground-water system through fractures and solution openings. Dewatering of one underground coal mine was the only known manmade discharge from the ground-water system in the study area during 1980. Chemical quality of ground water generally was suitable for most uses; dissolved-solids concentrations in water from 87 springs ranged from 105 to 1,080 milligrams per liter and averaged about 380 milligrams per liter. 29 references.

23429 **(USGS/WRI—83-4069) Hydrology and subsidence potential of proposed coal-lease tracts in Delta County, Colorado.** Brooks, T. (Geological Survey, Lakewood, CO (USA)). Mar 1983. 33p. US Geological Survey, Box 25425, Federal Center, Denver, CO 80225. File Number TI85901307.

Potential subsidence from underground coal mining and associated hydrologic impacts were investigated at two potential coal-lease tracts in Delta County, Colorado. Alteration of existing flow systems could affect water users in the surrounding area. An inventory was made of 20 wells (18 in the Paonia study area and 2 in the Cedaredge study area) and 16 springs in the Paonia study area. Wells completed in the Mesaverde Formation yielded a sodium bicarbonate type water. Water levels in wells ranged from 149 to 2209 feet below the land surface in the Paonia study area and were 25 and 217 feet below the land surface in the Cedaredge study area. Spring discharges in the Paonia study area ranged from 0.02 to 8.41 gallons per minute. The waters were of the calcium sodium bicarbonate type. Tests conducted in October 1982 indicated that Terror Creek in the Paonia study area lost 0.59 cubic foot per second along about 1.5 miles of thin alluvium overlying the lower Mesaverde Formation. Measurements in the same week indicated that Oak Creek in the Cedaredge study area gained 0.92 cubic foot per second along about 1.5 miles of thick alluvium overlying the Mesaverde Formation. The stream waters were a calcium bicarbonate type. Mining beneath Stevens Gulch and East Roatcap Creek could produce surface expressions of subsidence. Subsidence could partly drain alluvial valley aquifers or streamflow in these drainages. 21 refs.

23430 **(USGS/WRI/OFR—81-913) Ground-water hydrology of strip-mine areas in eastern Ohio (conditions during mining of two watersheds in Coshocton and Muskingum counties).** Helgesen, J.O.; Razem, A.C. (Geological Survey, Columbus, OH (USA)). 1981. 29p. US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901362.

Ground-water conditions during coal strip mining in two small watersheds are described as part of an ongoing study of effects of mining on hydrologic systems. Both watersheds were underlain by stratified sedimentary rocks containing two perched aquifers above clay beds which underlaid the major coal seams. Mining involved removing the overburden rocks, including the top aquifer, stripping the coal seam, and recontouring the overburden spoils to the approximate premining shape of the watershed. Water levels in the top aquifer declined as mining neared the watersheds, but destruction of observation wells precluded a record of any decline during mining in the watersheds. Depletion of the top aquifer was reflected in base flow of streams, which was reduced and more highly mineralized after mining. Initial saturated thickness of replaced overburden spoils ranged from 0 to 4 feet, based on data from observation wells installed immediately after reclamation. Down-hole specific-conductance measurements of water in the spoils suggest the presence of more highly mineralized water than that in the premining top aquifer. No significant effects of mining are evident on ground-water levels or quality beneath the stripped coal. 3 refs., 14 figs., 2 tabs.

0120 Mining

REFER ALSO TO CITATION(S) 23497

23431 (CONF-830669—, pp 88-89) **Summary report of the Panel on Climate and the Coal Industry.** Wilson, J.S.; Dethier, B.E. Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

The principal consumption of coal in the US at present is in electric utilities with smaller quantities burned in the industrial sector. A potentially large future use is in the production of synthetic fuels, which may substitute for oil gas. Because of the existence of separate panels to consider electricity generation and gas, the coal panel concentrated on the production and delivery of coal to its end user and not on the specific end use. In its discussions, the panel segmented the activities of the industry into four categories: (1) plant siting and permitting; (2) coal production (mining, coal cleaning, and storage); (3) mined-land reclamation (primarily for strip mining); and (4) transportation of coal from the mine to the end user. The panel concluded that, although climate information is needed and used in each activity of the industry, other factors are often more important in the planning and execution (for example, labor considerations, price of coal at various times). Weather factors are currently built into the process by allowing for worst case situations and accepting the extra costs associated with the assumptions. It was generally agreed that more use could be made of climatic data, but a significant education process would be needed to have general acceptance of such information.

23432 (CONF-830669—, pp 90-96) **Impact of weather on the coal industry.** Boyer, J.F. Jr. (Bituminous Coal Research National Lab., Monroeville, PA). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

The impacts of weather on underground mining, surface mining, coal handling and transportation, and on coal utilization are summarized. In general, weather has a significant influence on these operations. Normal adverse weather conditions are anticipated when developing operating plans. Climatic data and weather forecasts presently receive minimal use. If future use is to be increased, this information will have to become more site specific and more reliable than is currently available.

23433 (DOE/EIA—0121(84/4Q)) **Quarterly Coal Report, October-December 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Apr 1985. 79p. NTIS, PC A05/MF A01 - GPO; GPO Dep. File Number DE85010008.

The "Quarterly Coal Report" provides comprehensive information about coal production, exports, imports, receipts, consumption, and stocks in the United States to a wide audience, including Congress, federal and state agencies, the coal industry, and the general public. The data were collected by the Energy Information Administration (EIA) to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (P.L. 93-275) as amended. This issue shows detailed quarterly data for October-December 1984, aggregated quarterly historical and projected data for 1980 through 1985, and aggregated annual historical and projected data for 1960 through 1995. All data for 1983 and previous years are final. The 1984 data on production and electric utility receipts (quantity and price) are preliminary and subject to revision. All other 1984 data are final. 24 references, 8 figures, 50 tables.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 23910

23434 (DOE/EIA—0468) **Coal slurry pipelines: impact on coal markets.** Hong, B.D.; Hickman, J.G.; Schnapp, R.M. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Apr 1985. 58p. NTIS, PC A04/MF A01 - GPO; GPO Dep. File Number DE85010469.

This analysis indicates that: Coal slurry pipelines could be competitive with railroads, if the projected pipeline and rail rates actually prevailed; coal users could realize savings of between $200 million and $1 billion in 1995, if the four coal slurry pipelines analyzed were built and operated at the estimated rates; the railroads could be adversely affected by coal slurry pipeline operations (about 8% less revenues with between 44 and 48 million tons of coal carriage lost), but railroad revenues from hauling coal in 1995 would still be between about one-half and two-thirds greater than those of 1984; and only minor shifts in the regional coal production pattern would occur as a result of coal slurry pipeline operations. This analysis has qualifications and limitations just as any other analysis. The coal pipeline rates used in this analysis may not necessarily be the actual rates that would prevail. This analysis considered neither the costs associated with retrofitting existing power plants to burn coal slurry nor other possible benefits of burning coal slurry. Rail rates, reflecting rail costs, were assumed to rise at slow but steady rate in the future; the potential for the railroads to lower their rates to overcome competition from coal pipelines was not considered. It is important to note that neither the grant of federal eminent domain for coal pipelines nor the potential transportation cost savings from coal pipeline operation can guarantee actual construction of coal pipelines. Eminent domain, however, would certainly remove the barriers to market entry that prevent competition. Actual construction of coal pipelines will depend largely on whether electric utility operators perceive their potential cost savings to be sufficiently large to warrant the risks associated with coal pipelines. 4 figs., 12 tabs.

23435 (DOE/ER/10659—T1) **Transport characteristics of slurries in pipelines: flow regimes and pressure drop. Final report.** Acrivos, A. (Stanford Univ., CA (USA). Dept. of Chemical Engineering). Mar 1985. Contract AT03-80ER10659. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009453.

Our research has uncovered a host of seemingly unrelated phenomena pertaining to the rheology of concentrated suspensions, to which we have provided explanations that have shed new light on our understanding of such systems. The principal phenomena in question are: (a) the observed resuspension of a settled bed of particles in a viscous fluid upon being sheared, (b) the existence of a shear-induced anisotropy in a concentrated suspension which manifests itself in measurable normal stresses; and (c) slow decay with time of the effective viscosity of a concentrated suspension, as measured in a Couette viscometer, together with a shear thinning behavior in such systems. We have provided evidence that many of these phenomena arise as a result of the existence of shear induced diffusion mechanism which produces a flux of particles from regions of high particle concentration to low, or from regions of high shear to low. The overall goal of this combined experimental and theoretical program is a theoretical framework, currently lacking, for modelling the flow behavior of concentrated suspensions quantitatively. 9 refs.

23436 (DOE/SF/12218—T1) **Rail transport of western coal: the history of rail deregulation and its influence on western coal resource development; prospects for legislative change.** Smith, J.N.; Rose, R.R. (Western Governors' Association, Denver, CO (USA)). Apr 1985. Contract FG03-84SF12218. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009864.

The one major cloud on the horizon for the future of western coal outside the region is the high cost of transportation. With rail transportation costs running as much as 75% of the delivered price to some of the Gulf States, the ability to keep rail costs in check becomes critical to the future of western coal. Four years of experience with deregulation of the railroads and the performance of the Interstate Commerce Commission (ICC) under the new regulatory environment have led many shippers and buyers of rail transported commodities to the belief that national legislation is needed to give better protection to shippers in monopoly service areas. A tentative legislative effort began in the last Congress. Proposals for rail rate relief for captive shippers are taking more formidable shape in the 99th Congress with the organization of a well-financed and staffed coalition of coal and utility companies. They are seeking amendments to the Staggers Act which more explicitly define the protections and procedures available to captive shippers in advancing complaints through the ICC. Industrial shippers have formed a coalition of their own for fair rail service practices. Finally, another group has emerged in recent months seeking a bolder strategy for rail rate relief. This group asserts that unfair rail practices violate the antitrust laws. At the same time, the railroads are building their defenses and developing alliances with interests in the shipping community that would resist a return to greater rail regu-

lation. While the outcome of this controversy is uncertain, the issue of rail rate equity and reregulation promises to become one of the more active and hotly debated issues in the 99th Congress. However it comes out, the results will have a lasting impact on many western states, their present economy and future development.

23437 (ERP/CRL—83-20(R)) Investigations into the behaviour of methane emission and migration within coal storage silos at Line Creek Mine. Kolada, R.J. (Canada Centre for Mineral and Energy Technology, Ottawa, Ontario). Oct 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901633.

The release of methane from coal stored in a silo may present an explosion hazard if there is insufficient ventilation to prevent methane accumulations. Inquiries made by the B.C. Mines Inspectorate of an explosion within a coal silo in western Canada in 1982 indicated that an ignitable concentration of methane occurred, which in turn implies that the existing silo ventilation was inadequate. Consultations with the British Columbian Mines Inspectorate and several western Canadian mine operators resulted in the agreement that research into current coal silo ventilation techniques, and the factors affecting the rate of release of methane from coal stored in silos, could be of practical value in identifying how ignitable methane concentration may accumulate and how they may be prevented in the future. Due to the degassed nature of the coal mined at Line Creek it has not been possible to investigate the mechanisms of methane release and migration within a silo. However, the investigations at Line Creek has resulted in the development of equipment and experimental procedure to do this. Consequently it is recommended that the investigations carried out at Line Creek should be performed at another mine where the coal is known to have a significant methane content. 1 ref., 5 figs.

23438 (STEV-TORV—83-4) Equipment in the pulp-, paper- and board industry suited for dewatering peat. Boden, K. (Statens Energiverk, Stockholm (Sweden)). Apr 1983. 33p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751420.

The aim of this project is to investigate whether the existing equipment within the pulp, paper and board industries, can be used for mechanically drying peat. If then the peat mining would be done with an excavator, dredger or something similar, to allow deep mining. Using this method mechanical drying, mining could be done during a longer period of time, enabling a more reliable planning of activities. Also, a much smaller area would be necessary for the same volume of production than in the case of milled peat and machine-macerated peat production. That has been judged to be most suitable includes mechanical presses such as barking presses, rotating disc presses and screw presses and press sections with bands. The investigation gives details regarding production capacity in certain respects, but only a trial run of the equipment can give the actual production results. However, it would hardly be possible to dry the peat mechanically to a lower water content than 65-70 %. For further drying, it would be necessary to relay upon thermal or thermo-physical methods. Certain details regarding costs are given in the investigation. Today it ought to be possible to produce peat products at sound marketing prices. To produce pellets to sound market prices would probably be difficult without considerable subsidies. Better drying technique is expected to contribute to a more competitive pellet price in the future. At present no trial runs have been done, but it seems reasonable to assume that the three types of mechanical presses listed in the inventory (barking presses, rotating disc presses and screw presses) can only be used in the case of low-humificated pet (h1-H4). The press sections with sieve bands ought, on the other hand to have a certain affect even on medium-humificated peat. High-humificated peat (H7-H10) is estimated to be more or less impossible to dry with the equipment mentioned in the inventory.(author).

23439 (TNO-KRI—201-83-Pt.3) Extrusion of coal. Part 3: extrusion. Bultink, C.A.J.; Den Otter, J.L. (Plastics and Rubber Research Inst. TNO, Delft (Netherlands)). Jul 1983. 48p. Plastics and Rubber Research Institute TNO, Delft, Netherlands.

Hot extrusion tests for feeding coal in its plastic state to a combustion facility were carried out on Polish and Belgian coal. In these experiments, carried out on a 30 mm and a 50 mm single screw extruder, Belgian coal was extrudable at temperatures of about 500 deg C. The maximum output found on the 50 mm extruder at 60 rpm was about 90 gr/min of a foamy plastic coal. The process was not suitable for Polish coal and for extrusion at high pressures. On a 60 mm single screw extruder the coal extrusion process was further investigated. Cold extrusion tests for feeding coal in its solid state to a combustion facility were carried out on Polish coal. For stable extrusion of coal it was necessary to use a fully grooved cylinder. In these experiments coal was extrudable against high pressures (about 20 bars) and with additives such as limestone, water, oil and impurities like rubber and wood. The output of the 60 mm extruder at 150 rpm varied between 4000 gr/min for dry coal and 2700 gr/min for wet coal (water content 7.5%). For stable hot extrusion of coal in its plastic state it was concluded that a single screw extruder should have a fully grooved cylinder in those parts of the extruder where the coal is not plastic. Scouting tests were performed for cold extrusion through pipes and for the partition of a coal stream, coming out of the extruder, into two pipes. Adding 15% of oil, coal could be extruded through a pipe with a length of 13 diameters (diameter was 60 mm). Partition of the coal stream, based on an alternating division principle, was not yet satisfactory. The oil injection devices and the lay-out of the geometry of the partition die should be improved. (J.C.R.)

23440 (TNO-KRI—201-83(Pts.1,2)) Extrusion of coal. Part 1 and 2. Bultink, C.A.J.; Den Otter, J.L. (Plastics and Rubber Research Inst. TNO, Delft (Netherlands)). Aug 1983. 48p. Plastics and Rubber Research Institute TNO, Delft, Netherlands.

Experiments on the extrusion of coal were done in two ways. Hot extrusion, whereby coal is fed to the combustion chamber in its plastic state. Cold extrusion, whereby the extruder is used as a solids conveying pump. Physical measurements showed that for hot extrusion Belgian coal out of the Zolder mines should be extruded at about 430 deg C and Polish coal of mixed origin at about 480 deg C. In those parts of the extruder where the coal becomes plastic, lubrication will be necessary to prevent sticking of the coal to the metal surfaces. Friction measurements on Polish coal with lubricants show that oil can be used as an external lubricant. At low temperatures the addition of 10% of oil to Polish coal reduces the factor of external friction with about 50%. At temperatures above 60 deg C the oil is absorbed by the coal. Plasticwaste is a good external lubricant above 110 deg C. As an internal lubricant it acts also satisfactorily at temperatures below 110 deg C. The addition of ash and/or limestone does not affect the friction factor substantially. Cold extrusion experiments on a 60 mm extruder showed that when a fully grooved cylinder is applied, stable extrusion of coal is possible against high pressures, and with additives such as water, oil, limestone, ash and impurities like rubber and wood. Partition of the coal stream into two pipes based on an alternating division principle showed that the lay-out of the geometry of the partition die and the oil injection devices should be improved. (J.C.R.)

23441 Federal coal cleaning research and development program. Dietz, A.G. Jr.; Voelker, G.E. (Dept. of Energy, Washington, DC). *Energy Progress;* **4**: No. 4, 201-204(Dec 1984).

The Department of Energy's Fossil Energy Coal Preparation Research and Development Program has made significant technical accomplishments in the areas of microcharacterization, chemical benefaction, physical benefaction and comminution. These advances are discussed.

0140 Combustion

REFER ALSO TO CITATION(S) 23379, 23381, 23745, 24240, 24241, 24245

23442 (CONF-8206274—) Advanced diagnostic techniques for the combustion of coal and coal derived fuels: workshop. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). 1982. Contract FG22-82PC50260. 55p. NTIS MF A01; 2; GPO Dep. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

The workshop on "advanced diagnostic techniques for the combustion of coal and coal derived fuels" was held June 28-30, 1982, at the Carnegie-Mellon University, Pittsburgh, PA. It was sponsored by the Department of Energy, Pittsburgh Energy Technology Center, and the Center for Energy and Environmental Studies at Carnegie-Mellon University. Eleven items have been entered individually into EDB and ERA. (LTN)

23443 (CONF-8206274—, pp 15-17) **Laser-induced fluorescence as a combustion diagnostic tool.** Crosley, D.R. (SRI International, Menlo Park, CA). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

Laser-induced fluorescence (LIF) is a member - together with spontaneous and coherent Raman scattering - of the family of laser spectroscopic probes with which one can obtain information on specific, identifiable molecular species in combustion systems. In LIF, a laser is tuned so that its wavelength matches that of some absorption of the molecule of interest. Absorption of the laser photons excites the molecule to an upper electronic state which then fluoresces; detection of this emitted photon forms the signal. From the intensity is determined the concentration of the ground state of the probed species; temperatures are generally measured by scanning the laser to obtain the population distribution over internal rotational and/of vibrational levels. The absorption cross sections for electronic transitions are large, because a real electronic excited state is involved, and LIF consequently has very high sensitivity. In atmospheric pressure flames, concentrations at the part-per-million level can be readily measured with high spatial resolution. LIF is thus the desired laser probe technique for the measurement of those transient free radicals, present at low concentration, which are the intermediates in the chemistry of combustion. (By contrast, the Raman methods are suitable for majority flame species, which for spectroscopic reasons are generally difficult to detect with LIF, so that there is a pleasing complementarity among the methods). At present, about twenty atomic, diatomic, and triatomic naturally-occurring flame intermediates have been detected with LIF, and the list continues to grow at a steady pace.

23444 (CONF-8206274—, pp 18-22) **Spatially-precise laser diagnostics for temperature measurements in coal combustion.** Eckbreth, A.C. (United Technologies Research Center, East Hartford, CT). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

Laser probing of practical combustion processes offers the potential for the remote, spatially-precise, in situ measurement of, among other parameters, gas temperature and species concentrations. Laser techniques, due to their remote nature, are particularly attractive for probing particulate laden flows typical of the combustion of coal or coal-derived fuels. Absorption spectroscopy, CARS (coherent anti-Stokes Raman Spectroscopy) and laser-induced fluorescence have all been successfully employed in highly sooting flames. CARS is the most highly developed and, probably, the most generally applicable. Thermometry can be performed from any of the dominant molecular constituents including homonuclear diatomics. Absorption and fluorescence are generally performed from an unstable radical species which is usually not present in high enough concentrations throughout the entire temperature field, thus restricting spatial applicability. This can be remedied by addition of a seed species which may or may not be inconvenient. To date CARS has been numerously demonstrated in simulations of liquid-fueled gas turbine combustors, internal combustion engines, shock tubes, solid propellant flames and simulated MHD flows. CARS is readily multiplexed permitting single shot thermometry leading to acquisition of probability distribution functions. Other coherent Raman techniques, such as stimulated Raman gain/loss spectroscopy, would undoubtedly work in highly sooting situations as well. 23 references.

23445 (CONF-8206274—, pp 23-24) **Optical measurements in coal combustors.** Daily, J.W. (Univ. of California, Berkeley). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

The essential difficulty associated with making optical measurements in coal combustors is the presence of the coal itself. Measurements in gas phase flows are simplified by the relatively minor interaction between light and gas. On the other hand, solid coal particles can absorb, scatter, refract, fluoresce and phosphoresce to a very great degree, completely destroying the very aspects of wave propagation that make optical techniques so desirable. Nonetheless, it seems possible to approach coal combustion in a way that offers hope. Some measurements have been made already. Others are in progress, or planned. By attention to the details of light-particle interaction, one may design methods which provide useful data over some range of operation. An analysis shows that virtually all current gas phase methods have some range of applicability in coal flows. Once beyond the regime of single particle scattering, however, many methods drop out and innovation is required to continue in denser flows.

23446 (CONF-8206274—, pp 25-30) **Density and concentration measurements. Part II. Simultaneous measurements of two or more quantities.** Laurendeau, N.M. (Purdue Univ., West Lafayette, IN). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

Three laser diagnostic techniques are particularly suitable for simultaneous temperature and concentration measurements in turbulent, particle-laden flows: spontaneous Raman scattering, coherent Anti-Stokes Raman scattering; and laser-induced fluorescence. For each technique, spatially (0.1 to 1.0mm^3) and temporally ($<$ 10 ns) resolved measurements can be made by using pulsed lasers. A statistically significant number of single pulse measurements will generate probability density functions (PDFs); PDFs can then be used to compute average properties and property fluctuations, though caution must be exercised to avoid PDF skewing when sampling under highly turbulent conditions. Simultaneous measurements will provide PDFs for various concentration-temperature correlations; such information is important for the theory of turbulent combustion and the modeling of turbulent reactive flows. Development of the multi-function capability of laser diagnostics will also enhance the utility of optical setups for practical combustion systems. In spontaneous Raman scattering, a single laser beam can, in principle, be used to monitor all species of interest. However, Raman scattering is only feasible under clean conditions. Raman scattering work at General Electric now provides simultaneous, single pulse measurements of temperature and the concentrations of H_2, H_2O, N_2, and O_2. Concentrations are measured by monitoring the intensity of the Stokes signal; temperature is obtained by taking the ratio of the Stokes to anti-Stokes signal using N_2 or H_2. Additional photomultipliers can be used to monitor other species as long as the Raman vibrational signatures do not overlap.

23447 (CONF-8206274—, pp 31-33) **Particle/droplet size and number density measurements in coal combustion.** Hirleman, E.D. (Arizona State Univ., Tempe). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

The particles and droplets of importance in the combustion of coal and coal-derived liquid fuels range in size from submicron ash up to primary coal particles in atomized slurries of several hundred microns. The need for particle diagnostics derives from several factors including environmental impact of emissions, turbine blade erosion, and combustion efficiency as affected by fuel fragment sizes. Laser/optical diagnostic techniques hold a number of substantive advantages over conventional batch sampling techniques which have flow interference and sample integrity problems; indeed in many hostile combustion environments optical techniques provide the only hope for meaningful measurements. Despite con-

siderable progress a number of serious questions and uncertainties remain concerning in situ laser light scattering measurements in coal combustion environments. This paper reviews the fundamentals of laser/optical particle sizing techniques for in situ applications with emphasis on the non-ideal effects encountered in practical measurements. Laser/optical methods can be considered in three categories: imaging/holographic methods; ensemble scattering/extinction techniques; and single particle counters (spc). These three approaches each have unique advantages and limitations. Holographic methods potentially contain the most information but are relatively expensive, only applicable for particle sizes greater than about 5 um, and require very sophisticated (and expensive) on-line processing of the 3-D data for quasi-realtime operation. Ensemble techniques utilize the aggregate light scattering properties of an ensemble of particles to infer properties of the size distribution.

23448 (CONF-8206274—, pp 34-37) **Particle/droplet size and concentration measurement techniques.** Self, S. (Stanford Univ., CA). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

The range of applications and the variety of potential measurement techniques for coal-related combustion sytems are very diverse. Particle sizes of interest extend from $\sim 10^{-3}$ micron (nucleation, soot, formation) to approx. 100 micron (sprays, pulverized fuels and fluidized beds), or a range of 10^{5}:1. In general the size distribution evolves with time due to evaporation, condensation, gas-phase accretion, and agglomeration (coagulation) together with loss to surfaces by settling, impaction and diffusion. It is convenient to divide the size range into super- and submicron classes. The former is observable by optical microscopy while the latter requires electron microscopy. Moverover, there is a more or less marked distinction with regard to dynamical behavior. Particles larger than about 1 micron increasingly exhibit gravitational (settling) and inertial (impaction) effects, whereas the motion of submicron particles is dominated by diffusion (turbulent and Brownian). In addition it is convenient to make a size division at about the wavelength of visible light ($\sim$ 0.5 micron) because MIE scattering theory has different asymptotic forms for particles much larger or smaller than the wavelength. Available techniques for determining particle size are numerous, diverse and tend to be specific to particular applications. Most methods are applicable only over a limited size range of one to two orders of magnitude. Many of the established techniques applicable to aerosols at ambient temperature and pressure, or for use on small scale laboratory installations, cannot readily be extrapolated to large scale combustion systems. Measurement techniques may be classified in various ways. Besides the obvious classification by the applicable size range, methods may be classed according to the basic principle employed, e.g. aerodynamic, optical, electrical, etc.

23449 (CONF-8206274—, pp 38-40) **Velocity measurements with LDV in particle laden reacting flow.** Fingerson, L.M. (TSI Inc., St. Paul, MN). 1982. D. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

Laser Doppler Velocimetry is one of the few techniques that can even be considered for velocity measurements in particle laden reacting flows. It is non-invasive, can measure high turbulence intensities, and potential accuracy is high. The first and most obvious requirement is that the incident beam(s) can penetrate to the measuring point and the scattered light can get back out to the photodetector. The necessary window may be difficult but is usually possible. It must be kept reasonably clean during a test and scratches or other surface damage will rapidly deteriorate the signal. Condensation, oil films, etc., can also obliterate useful signals. Bleed jets of an appropriate clean fluid, "cleaning" jets, wipers, and other ingenious devices have all been used to keep windows clean. If pressure can be equalized on both sides of the access port, the window might be eliminated, a significant advantage for measurements. Even with clean windows the reflections, flare, etc., can often be troublesome - especially in direct backscatter and for measurements close to solid surfaces. The problems of particle size and concentration are the source of two primary complexities of LDV: (1) the complex phenomena of light scattered from various kinds of particles, and (2) data reduction problems where the time availability of good data is a function of particle statistics in the flow field. The above has not considered problems of refractive index variations causing beam wander, signals from large particles not following the flow, and a host of other potential problems. After all these considerations, the final question is whether any measurement is possible and, if it is, then whether the mensurement will be of adequate quality to justify the effort.

23450 (CONF-8206274—, pp 41-43) **Laser doppler measurements in reacting flow with uncontrolled high particle densities.** Sommer, H.T. (Carnegie-Mellon Univ., Pittsburgh, PA). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

The transfer of technology from the laboratory environment to practical industrial production units requires careful and detailed analysis in order to prevent incorrect data interpretation and misleading or wrong conclusions. Since practical system dimensions are generally orders of magnitudes larger in geometric and dynamic scale than laboratory model experiments, a diagnostic technique developed for application in a laboratory-environment faces a variety of different problems when used in the real system configuration. These problems range from signal intensity reductions to a hostile environment restricting the use of a laboratory developed diagnostic technique. Optical diagnostic techniques such as the Laser Doppler Velocimetry (LDV) are affected in a variety of ways. Different occurrences which might be observed in large scale systems with stronger influence than in laboratory bench-type experiments are listed here; this has been done in order to initiate a discussion of the application of LDV in industrial coal combustion systems. The list is not complete, and the discussion may result in the conclusion that certain effects which have been suggested are of less influence than some others which have not been mentioned here.

23451 (CONF-8206274—, pp 44-45) **Simultaneous measurements of two or more quantities.** Lapp, M. (General Electric Corp., Schenectady, NY). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

Advances in combustion system analyses are to be expected from a variety of optically compatible, non-intrusive methods based upon radiative signatures that are presently under wide development, including LV, Rayleigh scattering, Raman scattering, coherent anti-Stokes Raman Spectroscopy (CARS), fluorescence, particle (MIE) scattering, tunable laser absorption, etc. Needless to say, tradeoffs exist among these methods corresponding to different requirements for optical access, instrumentation complexity, capability to probe "dirty" systems, ability to provide essential data otherwise unattainable, difficulty of data reduction, etc. Taken as a group, they provide substantial power in determining basic combustion properties when combined in various appropriate fashions. In particle- and aerosol-laden flows, characterizations of particle velocity fields, size distributions, composition, surface properties, etc., are of strong interest. Methods for simultaneous measurements of some of these properties have been studied, such as the visibility technique based upon laser velocimetry that can determine simultaneously a velocity component and particle diameter. For solid-gas systems, particle properties such as surface porosity, with mixing and chemical reactions occurring in submicron-size pores, present formidable measurement difficulties. These remarks have been confined to point measurements only; gradients, two-dimensional imaging, and holographic data are all possible to be considered and can be combined with other compatible measurement methods. 3 references.

23452 (CONF-8206274—, pp 46-47) **Laser tomography for temperature and concentration measurements in flames.** Semerjian, H.G. (National Bureau of Standards, Washington, DC). 1982. NTIS MF A01. File Number DE85008212.

From Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels; Pittsburgh, PA, USA (28 Jun 1982).

The need to make non-intrusive real-time temperature and species concentration measurements in highly non-uniform reacting flows has generated a great deal of interest in laser-based diagnostic techniques. Techniques which provide point measurements, such as laser Raman scattering, CARS, laser induced fluorescence, or Rayleigh scattering, have attracted most of the attention because of their capability to provide measurements with high spatial and temporal resolution. However, the low signal levels, requirement of powerful lasers and complexity of internal energy transfer processes limits many of these techniques to special applications. Techniques based on absorption or emission provide much higher signal levels and therefore sensitivity, and are less susceptible to interference effects. However, such line-of-sight techniques have found only limited usage due to their inability to provide spatially resolved measurements. A number of attempts have been made in the past to extend absorption/emission techniques to obtain temperature measurements with good spatial resolution. Recently, a multi-angular absorption technique (laser tomography) has been developed which utilizes line-of-sight measurements to provide point measurements across the flow field. Laser tomography involves absorption measurements along M equally spaced parallel beams at N equally spaced angles, forming an M x N data set from which it is possible to retrieve or reconstruct the original property field.

23453 **(DOE/ET/15457—1632) Long-Term Materials Test program. Quarterly report, January-March 1984.** (General Electric Co., Schenectady, NY (USA). Advanced Energy Programs Dept.). 1984. Contract AC21-79ET15457. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85003248.

Corrosion and erosion/corrosion testing of gas turbine vane and blade base alloys and a variety of protective coating systems under the Long-Term Materials Test program has surpassed 5574 hours. The Pressurized Fluidized Bed Combustion (PFBC) facility at Malta, New York continues to show an exceptionally high degree of reliability and consistency in performance. Operating conditions include a 1650°F bed temperature at 10 atmospheres pressure utilizing Pittsburgh No. 8 coal and a low alkali dolomite sulfur sorbent. After 2687 hours, unprotected nickel and cobalt base vane and blade alloys generally experienced corrosion rates of 1 to 2 mils/1000 hours at metal temperatures of 1100°, 1300° and 1500°F. Precious metal aluminide and MCrAlY coatings continue to show excellent corrosion resistance (<0.5 mils/1000 hrs) at 1500°F, but are susceptible to varying degrees of pitting attack at 1100° and 1300°F. Erosion/corrosion degradation rates at 800 to 900 ft/s, 1350°F and less than 100 ppM dust loading ranged from 1 to 4 mils/1000 h with corrosion predominately concentrated in areas of particle impaction indicating an erosion/corrosion synergism. 6 figures, 3 tables.

23454 **(DOE/FE/60181—136) Correlation of coal characteristics and fouling tendencies of various coals from the Gascoyne mine.** Hurley, J.P.; Miller, B.G.; Jones, J.L.; Finkelman, R.B.; Yeakel, J.D. (North Dakota Univ., Grand Forks (USA). Energy Research Center; Exxon Production Research Co., Houston, TX (USA)). Apr 1985. Contract FC21-83FE60181. 13p. (CONF-850565—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010357.

From 13. biennial lignite symposium on technology and use of low-rank coals; Bismarck, ND, USA (21 May 1985).

In an attempt to understand how low-rank coal chemical characteristics can be used to predict the coals' ash fouling behavior, three lignite samples were chemically characterized and burned under similar conditions in a 550,000 Btu/h pilot-scale combustor. The lignites were obtained from the Red, White, and Blue pits of the Gascoyne mine because they had similar geologic histories but markedly different ash fouling potentials. The Red and Blue pit coals produced ash fouling deposits with physical characteristics that could be partially predicted by the sodium/ash ratio in the coals. The relatively high weight and hardness of the White pit deposits could not be predicted using this one parameter, but may have been due to the high silica and ash content of the coal as well as the high potassium and low calcium concentrations in the deposit. 21 refs., 2 figs., 8 tabs.,

23455 **(DOE/MC/20333—1670) Test program to simulate PFBC tube bundle metal wastage. Final report.** Newby, R.A.; Kittle, W.F. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). May 1984. Contract AC21-83MC20333. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85001086.

The Westinghouse R and D Center conducted a series of laboratory-scale tests to (1) investigate two potential mechanisms for tube erosion in the IEA Grimethorpe PFBC tests: dense-phase abrasion and dilute-phase impact erosion; and to (2) compare the relative erosivity of several bed particle materials. Maximum dilute- and dense-phase velocities in the Grimethorpe unit were estimated from tube Bank A and tube Bank C test conditions and used to set the laboratory test conditions for the two units. Sand, raw dolomite and bed materials from Grimethorpe and from the New York University (NYU) PFBC facility were tested. With the maximum dilute- and dense-phase velocities estimated for Grimethorpe, tube erosion was substantial by both mechanisms for test durations of up to 100 hours. Dilute-phase impacts with fine sand resulted in local material losses at the impact point. Dilute-phase tests with coarse Grimethorpe bed materials, though, were not valid tests because of the short particle acceleration lengths available. The erosion pattern with the dense-phase testing led to a flattening of the tube face. The dense-phase erosion pattern was similar to the Grimethorpe tubes examined and described in DOE reports. We conclude that high-velocity, dense-phase streaming is the likely mechanism of erosion in the Grimethorpe unit. Tube erosion rates can be reduced by operating at lower fluidization velocities and with a smaller content of large particles (>2000 μm) in the bed. Behavior will change little with different types of sorbents and coals. High rates of particle attrition and tube deposition were also observed. 15 refs., 12 figs., 1 tab.

23456 **(DOE/PC/30215—5) Freeboard reactions in fluidized coal combustion. Technical progress report, February 1-April 30, 1982.** Beer, J.M. (Massachusetts Inst. of Tech., Cambridge (USA)). 1 Jun 1982. Contract FG22-80PC30215. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010079.

Carbon monoxide burnout in the freeboard is approximately pseudo-first order in the carbon monoxide concentration. The rate of CO oxidation is consistent with a mechanism in which the reaction $CO + OH = CO_2 + H$ is rate-controlled, and the OH radicals are in equilibrium with other hydrogen and oxygen-containing species. The OH concentration can be calculated from the O_2 and H_2O concentration using the equilibrium constant for the reaction $1/2\ H_2O + 1/4\ O_2 = OH$. The major PAH species in the freeboard during single-stage combustion were: naphthalene, methylnaphthalenes, biphenyl, dibenzofuran, phenanthrene, and benzo(b)thiophene. All of the major species except benzo(b)thiophene disappeared at approximately the same rate as naphthalene. The most potent mutagens among the compounds identified at the combustor outlet were fluoranthene, chrysene, and possibly 1- and 2-methylphenanthrene. Rate constants for naphthalene disappearance assuming destruction by OH, and equilibration of OH were factors of 0.4 to 4 times the values reported by Tully et al. for $C_6H_6 + OH = C_6H_5 + H_2O$. PAH reactions in the presence of calcium oxide may be important for PAH destruction when limestone is used as the bed material. The pressure fluctuations in a fluidized bed provide a relatively simple and reliable experimental method for the estimation of the bubble size distribution. However, the analysis of the observed fluctuating pressure record is quite complex. 8 references, 21 figures, 3 tables.

23457 **(DOE/PC/30215—T2) Freeboard reactions in fluidized coal combustion. Technical report, 1 August 1980-1 March 1981.** Beer, J.M.; Card, J.C.; Chaung, T.Z.; Chiu, K.S.; Gupta, A.K.; Mayo, J.E.; Walsh, P.M. (Massachusetts Inst. of Tech., Cambridge (USA)). Mar 1981. Contract FG22-80PC30215. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010080.

The report summarizes the technical progress made in study of freeboard reaction in fluidized coal combustion. The work focuses on the determination of the changes in the concentration of gaseous and solid reactants with the purpose of understanding how

the minimize gaseous emissions and char elutriation from fluidized coal combustors. A probe method for measuring the solid fluxes in the freeboard of the MIT 0.6 m x 0.6 m combustor was developed and tested. Data collected using these probes showed that the mass flow rate of solids decays exponentially with distance above the bed. A photographic technique was developed for taking photographs of particles through windows in the wall of the freeboard. The surface areas of fine and coarse particles were estimated by the method and some interesting solids flow patterns arising from the bubbling of the bed were observed. Carbon monoxide and hydrocarbon profiles were compared for single and two-stage combustor configurations. The carbon monoxide concentration at the freeboard exit was found to be very sensitive to the secondary air flow rate, indicating that the extent of CO burnout in the two-stage configuration can be improved by proper location and arrangement of the secondary air injector. CO profiles observed in the 0.6 m x 0.6 m combustor were compared with profiles calculated assuming a global CO oxidation rate law and again assuming that OH radicals are at partial equilibrium. The observed CO profile falls exactly between the two extreme assumptions, indicating that neither assumption by itself is an accurate representation of the actual CO oxidation process in the freeboard under the condition studied. Appendices A and B have been entered individually into EPA and ERA.

23458 (DOE/PC/30215—T2, pp 26, App. A) **Measurement of solids flux in the freeboard of a fluidized bed.** Mayo, J.E.; Walsh, P.M. Mar 1981. NTIS, PC A04/MF A01. File Number DE85010080.

In Freeboard reactions in fluidized coal combustion. Technical report, 1 August 1980-1 March 1981.

Apparatus was designed and built to enable the determination of solids loading in the freeboard of a fluidized bed combustor by measurement of the descending mass flowrate of solids at various heights. Experiments were conducted at various fluidizing velocities ranging from the minimum fluidizing velocity to approximately twice that value, and the samples collected were characterized for particle size distributions. Existing models for freeboard solids behavior were modified in order to express concentrations in terms of the quantities that were experimentally measured. An exponential decrease in freeboard solids entrainment was noted with increasing height, and an increase in entrainment with fluidizing velocity documented as well.

23459 (DOE/PC/30215—T2, pp 24, App. B) **Determination of polycyclic aromatic hydrocarbons in a coal-fired fluidized combustor.** Chiu, K.S.; Biemann, K.; Walsh, P.M.; Beer, J.M. Mar 1981. NTIS, PC A04/MF A01. File Number DE85010080.

In Freeboard reactions in fluidized coal combustion. Technical report, 1 August 1980-1 March 1981.

The objective of the study of PAH in the 0.6 m x 0.6 m fluidized combustor is to identify and quantify the species present; to examine variations with fuel type and operating conditions; and from the observed trends to establish, where possible, guidelines for minimization of PAH emissions from combustion of solid fuels in fluidized beds, at the same time maintaining low levels of NO/sub x/ and CO. In this report are presented data on the amounts and types of PAH identified in a sample withdrawn from the freeboard of the fluidized combustor while burning subbituminous coal.

23460 (DOE/PC/40267—5) **Combustion characterization of coals for industrial applications. Final technical report, January 1, 1981-May 29, 1985.** Nsakala, N.; Patel, R.L.; Lao, T.C. (Combustion Engineering, Inc., Windsor, CT (USA). Power Systems Group). Mar 1985. Contract AC22-81PC40267. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85010673.

In-depth fundamental information was obtained from a two-inch inner diameter laminar flow reactor referred to as the Drop Tube Furnace System (DTFS). This information consists of the following: (1) pyrolysis kinetic characteristics of four coals of various rank (Texas lignite, Montana subbituminous, Alabama high volatile bituminous, and Pennsylvania anthracite); and (2) combustion kinetic studies of chars produced from the foregoing parent coals. A number of standard ASTM and special in-house bench scale tests were also performed on the coals and chars prepared therefrom to characterize their physicochemical properties. The pilot scale (500,000 Btu/hr) Controlled Mixing History Furnace (CMHF) was used to determine the effect of staged combustion on NO/sub x/ emissions control from an overall combustion performance of the Alabama high volatile bituminous coal. The quantitative fundamental data developed from this study indicate significant differences in coal/char chemical, physical, and reactivity characteristics, which should be useful to those interested in modeling coal combustion and pyrolysis processes. These results underscore the fact that coal selection is one of the keys governing a successful coal conversion/utilization process. The combustion kinetic information obtained on the high volatile bituminous coal has been used in conjunction with combustion engineering's proprietary mathematical models to predict the combustion performance of this coal in the Controlled Mixing History Furnace. Comparison of the predicted data with the experimental results shows a virtually one-to-one scale-up from the DTFS to the CMHF. These data should provide vital information to designers in the area of carbon burnout and NO/sub x/ reduction for large scale coal utilization applications. 31 refs., 28 figs., 17 tabs.

23461 **(STEV-FBA—83-21) Combustion tests with pulverized fuels in a cyclone combustion chamber.** Eriksson, L. (Statens Energiverk, Stockholm (Sweden)). Sep 1983. 79p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751411.

The objective with this project has been to establish combustion conditions and characterize material handling, milling and parameters as combustibility, ashmelting, combustion efficiency and emission index, for refined and pulverized fuels from wood, peat and straw. Influence on NOsub(x) - formation, from exhaust gas recirculation to the primary combustion zone, has also been investigated. The combustion tests have given very promising results for the system with pulverized peat. The investigations have been carried out in a special testing plant equipped with a 2 MW cyclone combustor mounted on the top of a watercooled flametunnel. The biomass fuels with various particle sizes, content of water and heating values have been analysed and tested with the actual combustor design. Some of the conclusions from the test results are: It is possible to achieve very high combustion efficiency above 99.5 percent with all tested fuels. The gas analysis method used has proved to be a good and accurate evaluation method when comparing combustion characteristics for the different fuels. The relationship between primary and secondary air as well as mixing dynamics in the combustor between fuel and air, is of significant importance for good turn down ratio and for achieving low emission index of Co, HC and NOsub(x) formation. Peat combustion has the highest NOsub(x) formation of the fuels tested. It is possible to suppress the NOsub(x) level by using exhaust gas recirculation. However the NOsub(x) situation when burning peat has to be further investigated and related to data for different peat fuels. At combustion of fuels with high ash content at temperatures above the ash melting region, vertical connection of the combustor to the boiler system is recommended. It seems to be possible to control the peat ashmelting problem in the combustor and boiler system.(L.E.).

23462 **(STEV-FBA—84-21) Material loss from the heat exchange surfaces of the Chalmers 16 MW fluidised-bed boiler.** Johnsson, F. (Statens Energiverk, Stockholm (Sweden)). Jun 1984. 33p. (CTH-A—84-136). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751441.

The material loss from the heat exchange surfaces on the fluidised-bed boiler at Chalmers University of Technology has been investigated on several occasions since the boiler was put in operation in March 1982. Some observations on oxide layers were also made on the in-bed superheater. The investigation further includes study of different protective coatings on the membrane tube walls and superheater tubes. The results indicate that there is a considerable loss of material from the vertical membrane tube walls in the region of the bed surface. It seems possible to reduce the loss of material by applying protective coatings on the most critical parts of the heat exchange surfaces. However, further work is necessary in order to verify the properties of the present coatings and to find still more suitable coatings. It was also found important that the coatings are applied properly.

23463 (STEV-TORV—84-13) Full-scale tests of prepared pulverized peat powder and economic analysis. Final report. Kinnerberg, H.; Berglund, S.; Loeoef, R.; Sundqvist, J.O.; Soedergren, L.O. (Statens Energiverk, Stockholm (Sweden)). Oct 1984. 37p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751461.

Peat is of great interest for oil substitution, because it is a domestic, well supplied, cheap and accessible raw material. Dried pulverized peat powder fuel is, however, very dusty which makes it hazardous to handle. K-Konsult has found a special agent which flocculates individual peat particles into bigger agglomerates. The flocculating agent is a relatively cheap petroleum oil product with no harmful or polluting additives. An addition of only a few percent by weight of the flocculating agent is sufficient to make the peat powder dustfree. In a full-scale test, 12 tons of prepared peat powder was produced, transported and combusted. The tests showed that the peat fuel had good handling properties. The combustion tests were done in a 2 MW experimental furnace at Studsvik. Peat fuel was fired in a standard axial burner, a standard swirl burner and a commercial Schoppe-burner. The tests showed that the peat powder was comparable to a commercial coal powder fuel, though it was much coarser. The dust explosion characteristics of prepared peat powder were determined by Chr. Michelsen Institute. The tests showed that the peat powder was much less explosive than wood powder and coal powder fuels. An economic analysis has been done for a prepared peat powder fuel system, based on a peat powder fuel plant (capacity 125,000 tons/year) and about 15 users. The study has shown that the peat fuel has a production cost of 645 SEK/ton. The average transporting cost have been estimated to 70 SEK/ton (the transporting distance is 100 km for the average user). The users costs for converting the oil-fired heating plants have been calculated to 85 SEK/ton and the value of the substituted oil to 1000 SEK/ton peatfuel. That makes a converting -profit- of 200 SEK/ton peatfuel or 25 millions SEK/year.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 23920, 23931

23464 Brown coal in the Polish power system. Laudyn, D.A. (Power Engineering Studies and Design Office, Warsaw, Poland). *Energy Exploration and Exploitation;* 3: No. 2, 115-119(1985).

The production of electrical energy in Poland reached 118 TWh in 1982. Installed capacity of power plants reached 27,000 MW at the end of that year. Since the best grades of hard coal are utilized in other branches of Polish industry and for export purposes, the power plants have to fire the low-calorific grades of hard coal (as well as slurries and interlayers left from the coal washers and sorting plants) and brown coal. In 1982 brown-coal fired power plants produced 25 TWh of electrical energy, or 21% of the total national production. The capacity of brown-coal fired power plants reached 4743 MW at the end of 1982, or 17.5% of the total capacity of all power plants in the state. Polish power plants fed with brown coal are described briefly. 2 references, 1 figure, 3 tables.

0160 Health And Safety

REFER ALSO TO CITATION(S) 23386

23465 (BNL—36274) Quarterly status report on Kosovo study. First quarter, FY 1985. Morris, S.C. (Brookhaven National Lab., Upton, NY (USA)). Feb 1985. Contract AC02-76CH00016. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010549.

This is a study of industrial hygiene and health effects in the workforce of the coal gasification plant located in Oblic (outside Pristina) in the autonomous Province of Kosovo, Yugoslavia, operated by the combine Elektroprivreda Kosovo (EPK). The various organizations participating in the project each have their own objectives. These objectives are mutually compatible, and to some degree can only be achieved together. The Yugoslav objectives are to increase the scientific capabilities in the Kosovo area, to achieve greater protection of their workers, and to gain information which might help them decrease health and environmental effects in a modification or expansion of the present plant. US objectives are to gain information on health effects and industrial hygiene practices in a plant with a lengthy operating history. This information can be helpful in planning for US synthetic fuel plants. In a broader context, DOE, EPA, and NIOSH all have a need to develop means to estimate health effects of exposure to complex mixtures of organic pollutants related to fossil fuel use. The Kosovo study provides an additional approach to this problem.

23466 (KHM-TR—67) Retention, metabolism and distribution of B(a)P-coated coal and oil fly ash intractracheally instilled in Hamster. Ahlberg, M.; Persson, S.Aa.; Faengmark, I.; Larsson, R.; Emmelin, A.; Swahn, B.M.; Berghem, L. (Statens Vattenfallsverk, Vaellingby (Sweden). Projekt KOL-HAELSA-MILJOE). May 1983. 59p. (In Swedish). NTIS (US Sales Only), PC A04. File Number DE85751418.

The fate of benzo(a)pyrene, (B(a)P), and B(a)P-coated coal and oil fly ash and ferric oxide intratracheally instilled in hamsters was investigated. B(a)P and the metabolites B(a)P-7.8-dihydrodiol and B(a)P-9.10-dihydrodiol have been determined in lung, liver, kidney and gastro-intestinal tract for one week after a single intratracheal instillation, by means of HPLC-techniques. The lung clearance of fly ash and ferric oxide as well as the distribution in liver kidney and gastro-intestinal tract of elements leached from the fly ash have been measures by gamma spectrometry for 21 weeks after instillation of neutron activated particulate material. 90-99 % of the B(a)P disappeared from the lung within one day after instillation. In liver and kidney B(a)P decreased rapidly three hours after instillation. In the gastro-intestinal tract the B(a)P-concentration had a maximum at three hours after instillation and the decrease was slower than in the other tissues. Pure B(a)P decreased more rapidly from the lungs than B(a)P coated particles. The leachability in saline solution. pH 6.5, was high for most radionuclides in oil fly ash, a corresondingly high leachability of elements in coal fly ash was not reched until the pH was 1.3. The biological half lifes, determined by measurements on isolated lungs, for intratracheally instilled ferric oxide, oil fly ash and coal fly ash were found to be 61 +-25 days, 67 +-18 days and 47.7 +-3.1 days, respectively. Particles from coal fly ash was phagocytized in vitro by alveolar macrophages isolated from the animals through bronchopulmonary lavage. Contrary, particles obtained from oil fly ash was not engulfed by these cells due to the large particle size of oil fly ash.

23467 Evaluation of the genotoxicity of process stream extracts from a coal gasification system. Shimizu, R.W.; Benson, J.M.; Li, A.P.; Henderson, R.F.; Brooks, A.L. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Environmental Management;* 6: No. 6, 825-834(1984). Contract AC04-76EV01013.

Extracts of three complex organic environmental mixtures, two from an experimental coal gasifier (a raw gas and a clean gas sample) and one from a coke oven main, were examined for genotoxicity. Three short-term genotoxicity assay systems were used: Ames Salmonella typhimurium reverse mutation assay, Chinese hamster ovary cell/hypoxanthine-guanine phosphoribosyl transferase (CHO/HGPRT) gene locus mutation assay, and the Chinese hamster lung primary culture/sister chromatid exchange (CHL/SCE) assay. Aroclor-1254-induced rat liver homogenate fraction (S-9) was required to observe genotoxicity in both gene locus mutation assays (CHO/HGPRT and Ames). The relative survival of CHO cells exposed to extracts was highest in cells exposed to clean gas samples, with the raw gas sample being the most cytotoxic either with or without the addition of S-9. All three complex mixtures induced sister chromatid exchanges in primary lung cell cultures without the addition of S-9. The relative genotoxicity ranking of the samples varied between the mammalian and prokaryotic assay systems. The results of all three assays indicate that the clean-up process used in the experimental gasifier was effective in decreasing the genotoxic materials in the process stream. These data also reemphasize the necessity of evaluating genotoxicity of complex mixtures in a variety of short-term systems.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 23436

23468 Coal use by the nation's railroads. Hearings before the Subcommittee on Energy and Mineral Resources of the Committee on Energy and Natural Resources, United States Senate, Ninety-Eighth Congress, First and Second Sessions. Washington, DC; Government Printing Office (1984). 648p.

Three days of hearings, two of which were field hearings in the State of Virginia, addressed the potential for coal to fuel rail locomotives. The testimony covers the status of research projects and the pros and cons of using coal fuels in diesel-type locomotives. Employment in the coal industry, the economics of coal technology, and the need to reduce US dependence on imported oil are major factors in determining the feasibility of returning to coal as the major rail fuel. Predictions that coal-fired trains can be a reality in two-to-five years make an early assessment necessary. Additional material submitted for the record follows the testimony given by 25 witnesses from DOE, locomotive manufacturers and marketers, the coal industry, the railroad industry, and others.

02 PETROLEUM

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 24475

23469 (USGS-OFR—83-627) Geochemical profile of Tunalik No. 1 well, National Petroleum Reserve in Alaska. Banet, A.C. Jr. (Geological Survey, Denver, CO (USA)). 1983. 75p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901344.

Plotting recently released organic geochemical data against depth shows that the sedimentary section penetrated at the Tunalik No. 1 well is prone to generate gas. Treatment of fifteen geochemical parameters illustrates the organic quality, quantity, and thermal maturity of well cuttings and core samples. Major maturity indicators suggest that the section is thermally mature for oil from approximately 3300 feet to 10,500 feet (1006 to 3200 m). Kerogen types are predominantly herbaceous and humic and, consequently, yield mainly gas. Additional gas is generated from the thermal degradation of hydrocarbons buried beyond maturity. 16 refs., 2 tabs.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 24166

23470 (DGMK—202-1) Availability of carbon dioxide for enhanced oil recovery by CO_2-flooding in the Federal Republic of Germany. (Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg (Germany, F.R.)). 1981. 240p. (In German). Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

Results of investigations are reported on the natural occurrence of carbon dioxide and the availability of carbon dioxide for the crude oil production in the Federal Republic of Germany.

23471 (DGMK—202-2) Enhanced oil recovery by carbon dioxide flooding - laboratory research program and mathematical simulation. Pusch, G.; Meyn, R.; Meyn, V.; Leitenbauer, J. (Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg (Germany, F.R.)). Dec 1983. 168p. (In German). Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.

With 83 figs., 3 tabs.

Research results and field experience published especially in the USA indicate carbon dioxide flooding to be an effective EOR-technology under certain reservoir conditions. In this paper the research methods and results of a study group in Germany are outlined to evaluate the applicability of the carbon dioxide-technology in German oil reservoirs. Main topics of this report are pvt- and phase behaviour of sic selected crude/CO_2-systems with special reference to their importance for the oil mobilisation process; flood experiments in the laboratory and their numerical simulation by a reservoir model. The results are discussed against the background of their importance for field application.

23472 (DOE/BC/10326—10) Effect of pressure, time and composition on oil-water-surfactant systems for tertiary oil recovery. Final report. Good, R.J. (State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering). Jun 1985. Contract AS19-80BC10326. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85000129.

The scope and objectives of this work are as follows: (1) To determine the effect of pressure on interfacial tension in systems that are relevant to tertiary oil recovery. (2) To investigate the effect of pressure on the phase behavior of such systems. Both of these questions have a connection with mass transfer and dynamic liquid-liquid interfacial tension. (3) To investigate the nature of the microemulsion phase, and the occurrence, properties and behavior of microemulsions in general. (4) One objective that was not originally stated for the work was to elucidate an anomalous sedimentation effect that was discovered in the course of the study. This report is submitted in two subdivisions. These comprise, first (Part III of the report) 4 abstracts of the work of Dr. M.V. Ostrovsky, on microemulsions per se and the effect of pressure and time on interfacial tension. The second subdivision (Part IV of the report) consists of the work of Mr. Chan, Miss Chen and Miss Broers, on the effect of pressure on phase equilibria, and on the discovery of an anomalously rapid rate of sedimentation in microemulsions. Abstracts of their theses are presented. In addition, abstracts of two papers on anomalous sedimentation in systems containing microemulsions are presented.

23473 (DOE/ET/13077—104) Commercial scale demonstration enhanced oil recovery by micellar-polymer flood. Sixth annual report, October 1982-September 1983. Mueller, L.M. (Marathon Oil Co., Findlay, OH (USA)). Apr 1985. Contract AC03-78ET13077. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85000123.

This report is organized under two Work Breakdown Structures (WBS) which are summarized below. WBS No. 2100 - Fluid Injection: (1) Polymer injection has continued in varying concentrations. During the interim of October 1, 1982 and September 30, 1983, the polymer concentration was reduced from 411 ppM to 200 ppM and then to 100 ppM on the 2.5-acre pattern. The 5.0-acre pattern has remained at the same 625 ppM polymer concentration. (2) A change from bulk Dow 700 to bag Dow 700 polymer was made during 1983. The previously purchased bag polymer has been stored since the start of the M-1 Project. WBS No. 2300 - Performance Monitoring: (1) Subsequent to injection of tritiated water into ten injection wells, produced fluids from all oil wells have been analyzed monthly for the presence of tritiated water. During August, 1983, 29 wells showed the presence of tritiated water as compared to 77 wells in August, 1982. (2) Samples of produced water have been collected monthly and analyzed for water soluable sulfonate content (a micellar slug component). Analysis of sulfonate production shows 88% and 36% of the 2.5- and 5.0-acre patterns' wells respectively have fallen off peak sulfonate response. (3) Presently, the 2.5- and 5.0-acre patterns are producing at oil cuts of 3.2% and 8.7%, respectively. (4) The annual transient test results for the six injectors and their six offset producers are reported. The results are compared to previous years' results and indicate an increase in skin damage in the 2.5-acre pattern injectors and a generally increasing fluid mobility in the 2.5- and 5.0-acre patterns. (5) Core analysis data are presented for three core test wells which were drilled in the 2.5-acre pattern to compare slug and polymer swept sand intervals to the induction log calculated swept intervals in the offset observations wells. 24 figs.

23474 **(DOE/ET/13077—107) Commercial scale demonstration enhanced oil recovery by micellar-polymer flood. Monthly progress report, March 1985.** Mueller, L.M. (Marathon Oil Co., Findlay, OH (USA)). Mar 1985. Contract AC03-78ET13077. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010398.

This report describes work conducted on the Maraflood oil recovery process, M-1 Project, throughout the month of March 1985. Information is presented under two Work Breakdown Structure (WBS) elements: WBS 2300 - performance monitoring; and WBS 2400 - economic monitoring. Performance monitoring reporting includes discussions of the 2.5-acre and 5.0-acre pattern oil cut performance for March 1985. Economic monitoring discusses the abandonment of one producing well in the 2.5-acre pattern area of the M-1 Project. 15 figures.

23475 **(DOE/MC/21136—4) Improvement of CO_2 flood performance. Quarterly report, January 1-March 31, 1985.** Heller, J.P. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Apr 1985. Contract FC21-84MC21136. 73p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010683.

Progress has been made in each of the three major areas which our CO_2 flooding research is directed. In the phase behavior area, there is continuing effort for the refinement of the existing Continuous Multiple Contact (CMC) experiment. One of the high-pressure, oscillating crystal viscometers designed for use in this system has been completed, leak-tested and checked electrically. The entire CMC system is being reconstructed to fit into a temperature-controlled air bath, and for operation without use of mercury. The major new data from the reconstructed apparatus will concern the viscosities of the CO_2-rich and of the heavier fractions that may comprise part of the transition zone during displacements both above and below the MMP. The phase behavior and fluid properties activity has also produced further thermodynamic calculations and data for the correlation of MMP and oil composition. The second area of activity concerns the fluid-mechanical and chemical processes involved in displacement itself. Research in this category is concerned both with the microscopic or pore-level aspects, and with larger scale description. An important objective of this part of the work is to define and elucidate the dependence of reservoir-scale displacement behavior on those smaller-scale core and micromodel properties which are accessible to laboratory measurements. To this end, there are continuing observations of diffusion processes in CO_2 and of displacement mechanisms in etched-glass micromodels, as well as core-flooding studies. The third area of research on CO_2 flooding concerns another aspect of large-scale displacement phenomena - the effect of the unfavorable mobility ratio between displaced and displacing fluids. Progress is reported here on the selection of new surfactants for use in making "CO_2-foams," and also in the synthesis of polymeric solutes to increase the viscosity of dense CO_2. 29 refs., 27 figs., 3 tabs.

23476 **(DOE/SF/11445—4) Field experiment of improved steam drive with in-situ foaming. Final report.** Brigham, W.E. (Stanford Univ., CA (USA). Petroleum Research Inst.). 30 Sep 1984. Contract AC03-80SF11445. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85000126.

This report discusses the design, execution, results, conclusions and recommendations of a field experiment of improved steam drive with in-situ foaming by the surfactant Suntech IV in the Kern River Field of California. The project background, goals and field work are described. Several standards and experimental analytical methods have been applied to define the reservoir and to monitor the progress of the field experiment. The analysis of the results indicates that Suntech IV surfactant improved heavy recovery by steam drive with in-situ foaming and could successfully and economically be employed on a leasewide basis. 12 references, 22 figures, 7 tables.

23477 **Dual-cone double-helical downhole logging device.** Yu, J. S. (to The United States of America as represented by the United States Department of Energy). US Patent 4,489,276. 18 Dec 1984. Filed date 20 Jan 1982. vp.

PAT-APPL-341021.

A broadband downhole logging device includes a double-helix coil wrapped over a dielectric support and surrounded by a dielectric shield. The device may also include a second coil longitudinally aligned with a first coil and enclosed within the same shield for measuring magnetic permeability of downhole formations and six additional coils for accurately determining downhole parameters.

0204 Processing

REFER ALSO TO CITATION(S) 23392, 23413

0206 Health And Safety

REFER ALSO TO CITATION(S) 24470

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 23486, 23931, 23950, 23957

23478 **(DOE/CS/10047—T10) Inventory optimization in the US petroleum industry: empirical analysis and implications for energy emergency policy.** Hubbard, R.G.; Weiner, R. (Energy and Environmental Policy Center, Cambridge, MA (USA)). Aug 1983. Contract AT01-79CS10047. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008900.

Discussion Paper Series H-83-04.

This paper starts from the observation that the rapid increases in the price of crude oil during two of the last three supply disruptions can be attributed in part to increased private inventory demand stimulated by expectations of still higher prices (and hence speculative profits) in the future. To examine this phenomenon, we develop an optimizing model of inventory behavior in the petroleum industry and test it on United States data. Government intervention in any future disruption is likely to take the form of releases from the Strategic Petroleum Reserve (SPR). Given that the SPR accounts for but a small fraction of US oil inventories, the reaction of the private sector is critical in evaluating its impact. We incorporate inventory behavior in a small, empirically-estimated model of the world oil market, which is then linked to a short-run macro-econometric model of the US. We employ the linked energy-economy models to simulate a disruption and the effects of using the SPR on oil prices and private inventory behavior. Our simulations support the view that substantial inventory accumulation accompanies a supply disruption. In the debate over whether the SPR is potentially a potent or impotent resource in an emergency, we lean toward potency. We found that public releases were not absorbed in private stockpiles; indeed, their dampening price effects served, albeit slightly, to discourage speculative stock build. 20 references, 3 figures, 6 tables.

23479 **(DOE/EIA—0109(85/02)) Petroleum Supply Monthly, February 1985.** (USDOE Energy Information Administration, Washington, DC). Apr 1985. 111p. NTIS, PC A06/MF A01 - GPO; GPO Dep. File Number DE85010606.

US supply, disposition, and stocks of crude oil and petroleum products are reported for each year from 1973 through 1984, with monthly data given for the most recent 3 years. Detailed statistics are given for the most recent month available. Shown are: supply and disposition for the United States and each Petroleum Administration for Defense (PAD) District; production of crude oil and lease condensate by State and PAD District; natural gas processing plant production by PAD District; refinery operations by PAD District; imports and exports of crude oil and petroleum products; stocks of crude oil and products by PAD District; transportation between PAD Districts; and heavy fuel oils by sulfur content. A glossary, maps of various Districts, and explanatory notes discussing the data collection methodology are included. 13 figs., 33 tabs.

23480 (OCS/MMS—85-0004) Pacific Index, April 1983-October 1984. Molajo, D. (Rogers, Golden and Halpern, Inc., Reston, VA (USA)). Jun 1985. 92p. OCS Information Program, Minerals Management Service, 12203 Sunrise Valley Dr., MS 640 Reston, VA 22091. File Number TI85901335.

This index lists all relevant, actual or proposed programs, plans, and reports used by the Federal Government in pre- and postlease offshore oil and gas activities. Chapter 1 describes the Outer Continental Shelf (OCS) leasing process from a national perspective and discusses the 5-year leasing program. Also presented is information on the July 1982 OCS oil-and-gas leasing schedule and the tentative milestones scehdule issued subsequent to the July 1982 schedule. Chapter 2 discusses lease sales held in the Pacific OCS Region during the period covered by this Index and future sales scheduled for the region. Chapter 3 describes the steps in the pre- and postlease processes. Relevant documents produced from April 1983 through October 1984 are listed by lease sale for each step. Chapter 4 reports the ongoing Mineral Management Service (MMS) programs that support the OCS leasing process. The appendixes include directories of Federal and State OCS-related contacts and other information pertinent to the OCS leasing process. 8 figures, 8 tables.

23481 (ORNL/TM—9521) Future world oil prices: modeling methodologies and summary of recent forecasts. Curlee, T.R. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 84p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85010123.

This paper has three main objectives. First, the various methodologies that have been developed to explain historical oil price changes and forecast future price trends are reviewed and summarized. Second, the paper summarizes recent world oil price forecasts, and, then possible, discusses the methodologies used in formulating those forecasts. Third, utilizing conclusions from the reviews of the modeling methodologies and the recent price forecasts, in combination with an assessment of recent and projected oil market trends, oil price projections are given for the time period 1987 to 2022. The paper argues that modeling methodologies have undergone significant evolution during the past decade as modelers increasingly recognize the complex and constantly changing structure of the world oil market. Unfortunately, at this point in time a consensus about the appropriate methodology to use in formulating oil price forecasts is yet to be reached. There is, however, a general movement toward the opinion that both economic and political factors should be considered when making price projections. Likewise, there is no consensus about future oil price trends. Forecasts differ widely. However, in general, forecasts have been adjusted downwardly in recent years. Further, an overall assessment of the forecasts and recent oil market trends suggests that oil prices will remain constant in real terms for the remainder of the 1980s. Real oil prices are expected to increase by between 2 and 3% during the 1990s and beyond. Forecasters are quick to point out, however, that all forecasts are subject to significant uncertainty. 69 references, 3 figures, 10 tables.

23482 (WSG—82-2) Balancing unknowns: a decade of controversy about developing the outer continental shelf. Menard, H.W. (Washington Univ., Seattle (USA). Inst. for Marine Studies). 1982. 32p. University of Washington, Washington Sea Grant Communications, Seattle, WA 98195 $3.00. File Number TI85901302.

The author believes we can now identify most of the important factors that will influence the development of the outer continental shelf (OCS). He believes that the following are known: importing oil by tanker will cause more environmental degradation to the nation, although not uniformly, than development of the OCS; utilization of coal will cause more environmental degradation to the nation, and probably the world, than development of the OCS; short-term environmental effects of most oil spills are largely cosmetic and briefly economic; long-term environmental effects of multiple spills are unknown but will be greater from tankers than from OCS development in most regions; and conservation and the contribution of nuclear, solar and other sources of energy will reduce, perhaps greatly reduce, but not eliminate our need for additional fossil fuels during the next two decades. Development of the OCS thus has the potential of helping solve our national energy problem with a smaller risk to the environment than any comparable alternative. In this paper the author has attempted to show that many of the requirements of the leasing procedure for the OCS were logical in the absence of information when put in force, but they no longer appear so after a decade of acquiring data. Thus, a great opportunity exists for a major revision of the procedure that, once it is in effect, will save time, effort and money. The problem will not be to make a better procedure work - it will be to put that procedure into effect. To do so will require building a new and different consensus among diverse interests just at a time when they are increasingly polarized. Without due consideration for the views of all the interested parties, and appropiate consultation, leasing the continental shelf may be delayed for another decade before a new consensus emerges from the courts.

0209 Environmental Aspects

23483 (CONF-830669—, pp 26-30) Summary report of the Panel on Climate and the Oil Industry. Jones, R.; Riebsame, W.E.; Peters, D.J.H. (American Petroleum Institute, Washington, DC). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

The Panel on Climate and the Oil Industry had the following tasks: (1) to identify the climate-sensitive aspects of the US oil industry; (2) to identify problems and opportunities in the application of climate data to the industry; and (3) to review the usefulness of long-range forecasts in oil industry decision-making. The panel's discussions are summarized and its recommendations are presented.

23484 (CONF-830669—, pp 35-44) Improving the utility of climatic data to the oil industry. Leavitt, P.R. (Weather Services Corp., Bedford, MA). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

Interest in increased efficiency of our energy systems has resulted in a greater need for more precise estimation of the range of climatic variation, particularly the extremes of atmospheric and marine conditions. This means that climate data bases must be utilitarian, comprehensive, and accessible, providing a more extensive, longer-term record from which possible extremes can be extrapolated, an increased number of data points so as to provide a more representative set of values for determining cogent climatic features at any point within the area of data application, and archival storage methods that are amenable to data access for future acquisition and analyses. Such improved data bases are essential for the oil industry and other energy providers to more accurately plan their short- and long-term operations.

23485 (USGS-OFR—83-570) Oilspill risk analysis for the Diapir Field (June 1984) Outer Continental Shelf lease offering. Samuels, W.B.; Banks, D.; Hopkins, D. (Minerals Management Service, Reston, VA (USA)). Sep 1983. 140p. US Geological Survey, Box 25245, Denver Federal Center, Denver, CO 80225. File Number TI85901328.

This analysis characterizes the oilspill risks associated with the Diapir Field lease offering (June 1984). Assuming the conditional mean resource estimate, the proposed lease offering will result in an estimated 3.0 billion barrels of oil being found and produced off the North Alaska coast over a period spanning 27 years. There is a 16% chance that no spills of 1000 barrels or larger will occur and contact land within 30 days during the open water season. There is an 83% chance that sometime during this 27 year period 1 to 2 spills of 1000 barrels or larger could occur due to the proposed lease offering and contact land (during the open water season) after being at sea less than 30 days. The risks from spills would be mitigated to the extent that weathering and decay of oil occurs at sea, and by the success of any spill countermeasures which would be attempted; these effects were not directly included in this oilspill model, but should be considered in translating the spill contacts predicted by this study into spill impacts for environmental analysis. For purposes of comparison, risks from existing sources of po-

tential oilspills were also charterized over the same 27 year period as the proposed leases. These risks include all existing oil leases as well as tanker transportation of Canadian oil through the study area; together they represent more than 8 billion barrels produced and/or transported over 27 years. It is estimated that over the next 27 years these existing sources will result in 2 to 12 spills of 1000 barrels or larger occurring and contacting land during the open water season. (Again, these estimates do not include weathering or spill countermeasures). Two tract deletion alternatives were considered in this analysis. The probability that no spills will occur and contact land within 30 days is 18% while the east deletion increases this probability to 33%. 19 refs., 3 figs., 53 tabs.

0210 Legislation And Regulation

23486 **(DOE/CP/11915—1) Minimum markup laws in gasoline marketing: an economic analysis and a legal, economic, and legislative review.** (Synergy, Inc., Washington, DC (USA)). Mar 1985. Contract AC01-83CP11915. 319p. Synergy Inc., 2337 Eighteenth Street, NW, Washington, DC 20009. File Number TI85010205.

Accomplishments of the following four tasks are presented: (1) review of legal and economic literature which covers sales below cost laws, resale price maintenance laws, minimum markup laws and fair trade laws; (2) analysis of federal and state laws; (3) review of which states recently have considered or are now considering such legislation; and (4) analysis of the effects of minimum markup legislation.

23487 **Review of DOE's response to the committee report on emergency preparedness. Hearing before a Subcommittee of the Committee on Government Operations, House of Representatives, Ninety-Eighth Congress, Second Session, September 13, 1984.** Washington, DC; Government Printing Office (1985). 174p.

Energy Secretary Donald Hodel was the principal witness at a hearing reviewing DOE's preparation for an energy crisis of global proportions. The purpose was to learn what DOE has done in the past year to remedy the findings of a committee review of DOE's test response to an international oil crisis (AST-4) that found current emergency plans to be inadequate. Hodel responded that only net losses of oil supply could lead to problems, and cited several conditions which reduce the risk of a net loss of supply. He also noted the failure of government price and allocation efforts and the fact that impacts of higher oil prices on average households would be less than previously expected. He outlined four options for mitigating economic impacts. Additional correspondence and an appendix with DOE's response to the committee report follow his testimony.

0230 Properties

23488 **(DOE/BC/99880—7) Strategic Petroleum Reserve supporting research. Quarterly technical report, January 1-March 31, 1985.** Woodward, P.W. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). 31 Mar 1985. Contract AC03-84BC99880. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009342.

The basic objective is to provide technical support to the Strategic Petroleum Reserve Office (SPRO). This is accomplished by working through the Bartlesville Project Office. This support includes routine analyses, experimental research, and technical consultation at the SPRO's request. Progress on several tasks of the program has been delayed because the contract for FY 1985 has not yet been approved. Work on tasks 1 and 2 has been authorized to a maximum expenditure of $150,000. Sixty-two crude oil samples from various sources were logged into the laboratory this quarter for analysis. These crudes are listed in table 1. Inspection analyses have been completed for 60 samples and selections made for comprehensive analyses. The inspection data in table 2 indicate the blend of crudes in this particular West Hackberry cavern is very homogenous. In contrast, the data in table 3 exhibit clear evidence of stratification within another West Hackberry cavern. Table 3 compares analytical data from samples taken in 1982 to those from samples taken at approximately the same locations in 1984. The first two numerals in the sample number denotes the year the samples were taken. It is interesting to note the reverse trend in the nitrogen and sulfur values with depth, although very difficult to explain. 2 figures, 4 tables.

23489 **(DOE/ER/13230—T1) Study of the chemical mechanism in lubrication. Progress report, April 1, 1984-March 31, 1985.** Hsu, S.M.; Ku, C.; Gates, R.S.; Pei, P.; Munro, R.G. (National Bureau of Standards, Washington, DC (USA)). 1985. Contract AI05-84ER13230. 2p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010768.

Substantial progress has been made in the first year on the study in lubrication. Advances were noted in: theoretical modeling of the temperature profiles in a four-ball contact; modeling of elastohydrodynamic film thickness in a sliding contact; experimental studies of chemical reactions at concentrated contacts; analytical characterization of model chemical base oil structures; and the investigation of interactions between naturally occurring polar species and antiwear additives. The project has produced results scheduled to be presented in three publications. One paper, "Temperature Considerations in the Study of Surfaces Using a Four-Ball Wear Apparatus", by R.G. Munro, is scheduled to be published in the Journal of Applied Physics, May, 1985. This paper provides the first detailed theoretical discussion of the temperature distribution that occurs in the four-ball wear tester. The temperature distribution is crucial to the understanding of chemical mechanisms. A second work "Tribochemical Reactions at Concentrated Contacts", by S.M. Hsu, is scheduled to be presented at the International Tribology Conference in Tokyo, Japan, in 1985. The work proposes a sequence of reactions of bulk oxidation processes and the subsequent competing reaction sequence at the wearing surface. Results suggest direct organometallic interactions and indicate that the rates of those reactions are crucial to the effective control of friction and wear. Work has also been completed for the theoretical modeling of the combined effects of surface roughness, surface temperature profile, and elastohydrodynamic film thickness in a sliding contact. These results are critical for understanding the microscopic consequences of molecular structure for the mechanisms of lubrication.

23490 **(DOE/PC/60807—6) Supercritical fluid chromatography/supersonic jet spectroscopy. Progress report, November 1, 1984-January 31, 1985.** Lee, M.L.; Goates, S.R. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). Feb 1985. Contract FG22-83PC60807. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007005.

The uv chromatogram of the supercritical fluid fraction of a catalytically cracked petroleum bottoms sample and the gas chromatograms of the three fractions collected during the SFE demonstrate the capability of the SFF system to fractionate highly alkylated materials and 6-ring polycyclic aromatic hydrocarbons. The sulfur fraction of the catalytically cracked petroleum bottoms was also successfully fractionated. In addition, during this period, standard compounds were used to study the effect of mobile phase density on resolution of closely related compounds. It was found that, in general, the resolution of a pair of closely related isomers could be improved by as much as 100% by decreasing the mobile phase pressure at constant temperature on a given column. However, it was also concluded that the particle size of the packing in the column has a large effect on resolution as well. Initial supersonic jet spectrocopic results indicate that the distribution of the samples in the jet is relatively narrow. It will be important for us to more carefully map the sample distribution in order to maximize sample excitation and thus sensitivity of detection. 6 figures, 1 table.

0240 Storage

REFER ALSO TO CITATION(S) 23488

0250 Combustion

REFER ALSO TO CITATION(S) 23996

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 23491

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 23497

23491 (DOE/METC/SP—217) Western gas sands. (USDOE Morgantown Energy Technology Center, WV). Mar 1985. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85001985.

The purpose of this research is to demonstrate the feasibility of economically producing natural gas from low-permeability reservoirs. Two broad research goals have been defined: (1) reducing the uncertainty of the reservoir production potential, and (2) improving the extraction technology. These goals are being pursued by conducting research and encouraging industrial efforts in developing the necessary technology, including: (1) providing fundamental research into the nature of tight, lenticular gas sands and the technologies for diagnosing and developing them: (2) developing and verifying the technology for effective gas production; and (3) promoting the transfer of research products and technology advances to the gas industry in usable forms. The focus of the research for the last several years has been improving diagnostic instrumentation for reservoir and stimulation performance evaluation, geophysical and engineering interpretation, and stimulation techniques. Integrated geologic studies of three basins containing tight lenticular sands, which were selected by DOE as priority research targets, have also been pursued as part of this new effort. To date, the following tentative conclusions have been formed: Permeability of the tight gas sands can be as much as three to four orders of magnitude lower than that of conventional gas deposits. Nineteen western geologic basins and trends containing significant volumes of tight gas have been identified. Gas resources in the priority geologic basins have been estimated - Piceance Basin 49 Tcf.; Greater Green River Basin, 136 Tcf.; Uinta Basin, 20 Tcf. Presence of natural micro-fractures within a reservoir and the effective propped length of hydraulically induced fratures are the critical parameters for successful development of tight sand resources. Stimulation technology at the present time is insufficient to efficiently recover gas from lenticular tight reservoirs. 8 figs., 3 tabs.

23492 (LA—10374-PR) Western Gas Sands Project: Los Alamos NMR Well Logging Tool Development. Progress report. Final report. Brown, J.A.; Jackson, J.A.; Koelle, A.R. (Los Alamos National Lab., NM (USA)). Mar 1985. Contract W-7405-ENG-36. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85010356.

This document is the final report on the Los Alamos National Laboratory's Nuclear Magnetic Resonance (NMR) Well Logging Tool Development Program, part of the US Department of Energy (DOE) Western Gas Sands Project, most recently supported through DOE's Morgantown Energy Technology Center. The report covers the entire progress of the program from initial conception of the technique in 1978 to field testing of a prototype tool and contract termination in mid-1983. First, a theoretical development of the concept of a remotely-produced region of homogeneous magnetic field is presented, with its verification through laboratory measurements. The results provided confirmation of the concept and estimates of performance of a full-scale tool. A discussion of laboratory experiments undertaken to characterize the NMR response of saturated porous media is then given. The detailed results, presented in Appendix A, describe the limits of applicability of the NMR relaxation data acquired from the new logging tool. The development of the prototype downhole tool is then described, including magnet performance, development of NMR signal processing electronics, and an automated data acquisition system designed for use in downhole testing. Described next is the first downhole test of the prototype tool carried out in May 1983. The raw data acquired from this test, preliminary analysis, and a discussion of the result are then presented. Finally, preparations for extending the performance of the NMR logging tool by using superconducting magnets are described. A description of cryogenic equipment required for construction and testing of a laboratory mockup superconducting tool and initial performance data are given in detail. A summary of the project results and a discussion of potential improvements and inherent limitations of the technique complete the report. 14 references, 78 figures, 4 tables.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 23477

0305 Health And Safety

REFER ALSO TO CITATION(S) 24470

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 23480, 23482, 23931, 23956

23493 (DOE/EIA—0130(85/02)) Natural Gas Monthly, February 1985. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Apr 1985. 115p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. File Number DE85010480.

Current data on natural and supplemental gas consumption, disposition, production, prices, storage, imports, and exports in the United States are provided for each year from 1978 through 1984, with monthly data for the most recent 3 years. Some data are also given by State or city; some data are also given for previous years. Operating and financial data for major interstate natural gas pipeline companies, as well as data on filings, ceiling prices, and transportation under the Natural Gas Policy Act of 1978, are also included. Feature articles on current topics concerning the natural gas industry are published periodically. Explanatory notes, a discussion of data sources, and a glossary are included. Three reports previously published as separate annuals are now published in this report. The three are: "Underground Natural Gas Storage in the United States" (DOE/EIA-0239); "US Imports and Exports of Natural Gas" (DOE/EIA-0188); and "Main Line Sales of Natural Gas to Industrial Users" (DOE/EIA-0129). 5 figures, 16 tables.

0308 Environmental Effects

23494 (CONF-830669—, pp 46-57) **Summary report of the Panel on Climate and the Gas Industry.** Laurmann, J.A.; Hadeen, K.D. (Gas Research Institute, Chicago, IL). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

The energy industry has long recognized the significance of weather in the balancing of energy demand and supply. Recent past and future perceived energy supply shortfalls, and steep increases in energy prices serve to stress the importance of climate and weather interactions with energy use. The first of these factors implies that greater care is needed in meeting weather-sensitive energy demands, and the second results in increased sensitivity to user costs and energy industry revenues to climatic conditions. The gas sector is particularly vulnerable to climatic variations since a large part of total US gas consumption is in the highly temperature-dependent residential heating market. Recommendations of the Panel on Climate and the Gas Industry are presented and these are accompanied by brief indications of their motivation. Further explanation

and presentation of background material based on discussions occurring at the panel sessions are also presented.

23495 (CONF-830669—, pp 58-63) **Role of climate and weather in natural gas industry operations.** Roland, A.V. (American Gas Association, Arlington, VA). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

Climate and weather analyses have always been an integral part of natural gas industry operations. Some 30% of annual gas consumption is for residential and commercial spaceheating purposes, where the major determinant of demand is temperature. Gas transmission and distribution companies use historical weather data and short-term forecasts for calculation of daily gas send-out, supply planning, and ratemaking. While long-range climate forecasts are not useful for gas companies to plan on a day-to-day basis, the potential value of improved climate forecasting methods is great. The use of climate forecasts to plan six months ahead could result in significant savings in gas supply costs.

23496 (CONF-830669—, pp 64-77) **Climate, weather, and the natural gas industry.** Moriarty, J.E. (Federal Energy Regulatory Commission, Washington, DC). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

There is a strong need for the energy analyst and the meteorologist to listen to each other's words and begin a dialogue. Each has gone too long producing forecasts that are not really usable or performing impact studies that do not fully appreciate the meteorologist's data. A start toward bridging this gap is suggested and illustrations of the type of material required are provided. A case study is also presented to demonstrate an impact study.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 23491

23497 **(DOE/METC/SP—208) Coalbed methane.** (USDOE Morgantown Energy Technology Center, WV). Dec 1984. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85001982.

The DOE has made significant progress in developing the technology data base. To ensure that coalbed methane will contribute to the United States supply of natural gas, efforts will be on the following: characterize unmineable coalbeds (deeper than 2000 to 3000 feet), which account for over 90% of the available coal in the nation; characterize deep coalbeds (greater than 3000 feet) to permit engineering estimates of production performance; understand the mechanism of gas and water production simultaneously or sequentially to design production wells successfully; substantiate the production mechanism and efficiency of gas recovery so that forecasts of expected performance can be developed with confidence; and delineate the coalbed methane resource and recoverable reserves. Research activities are organized to meet the above challenges of technology development. As new information becomes available it will be transferred to the private sector to help them develop the resource. 5 references, 27 figures, 3 tables.

0320 Transport, Pipelines, And Handling

23498 **(SV-BKM—103-2) Material for natural gas pipelines.** Stenbacka, N. (Swedish State Power Board, Vaellingby). May 1982. 76p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751431.

The investigation deals with the toughness, strength and weldability of steel for line-pipes which form the tube sections of a pipeline. The quality of the steel should be very high and steel type X70 is selected, with a yield limit of 480 MPa. Considerable savings can be achieved by using type X80 with a yield limit of 550 MPa. Control of welds and material specifications must be thorough. Hydrogen embrittlement and cracking should be avoided.

23499 **(SV-BKM—105-2) Dimensioning of pipelines for natural gas using fracture mechanics.** Stenbacka, N. (Swedish State Power Board, Vaellingby). Apr 1982. 43p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751432.

The causes of static fracture initiation of pipelines are discussed. The reason may be internal overpressure and existing flaws. Experiments show that the rupture stress is dependent on yield strength if certain conditions considering fracture toughness and flaw length are fulfilled. A dynamic initiation as an impact load can increase the risk of fracture initiation. A confidence analysis of fracture mechanics is included.

23500 **(SV-BVM—115-2) Safety aspects of materials engineering of pipelines for natural gas.** Stenbacka, N. (Swedish State Power Board, Vaellingby). Feb 1983. 32p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751433.

Quality assurance and control of piplines is treated. The frequency of accidents shows that pipelines are 30 times safer than air transport and 10^3 times safer than road transports. The quality of steel has increased and the probability and causes of fracture are discussed. Statistical analysis of the requirements of impact toughness and a method for leak testing are described.

23501 **New developments in quality assurance of PE gas pipe.** Lustiger, A. (Battelle Columbus Laboratories, OH). *Gas Industry (London);* **28**: 8-15(Nov 1983).

Environmental stress crack resistance (ESCR) tests are useful in monitoring incoming lots of polyethylene (PE) pipe as supplied by the extruder. In addition to being economical, ESCR tools are difficult to equal in identifying a variety of resin- and extrusion-related lot-to-lot changes. This study summarizes the unique advantages and shortcomings of the compressed ring test, as well as those of three other ESCR tests - the modified compressed ring, constant tensile strain, and constant tensile load tests - now under development. Each gas utility that presently uses or plans to use ESCR for quality control purposes can choose on the basis of each test's capabilities and the unique requirements of each individual company.

0340 Combustion

REFER ALSO TO CITATION(S) 23952, 23972

04 OIL SHALES AND TAR SANDS

23502 **(DOE/METC—84-23) Proceedings of the Morocco-United States oil shale colloquium, October 1980.** (USDOE Morgantown Energy Technology Center, WV). Jun 1984. 643p. (CONF-8010382—). NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE84009251.

From Morocco/United States oil shale colloquium; Rabat, Morocco (1 Oct 1980).

Topics covered in this oil shale colloquium are: energy situation; geology and research; mining activities; direct combustion; retorting; refining; commercial variability of byproduct production; environmental control technologies; and commercial products. Individual papers have been processed for inclusion in the Energy Data Base.

0402 Site Geology And Hydrology

23503 **(NP—5901292) Potential oil recovery from Kansas oil shales.** Schlinsog, D.G.; Angino, E. (Kansas Geological Survey, Lawrence (USA)). 1983. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85901292.

Energy Resource Series 22.

Dark organic-rich shales are present throughout much of the stratigraphic column of Kansas. Some of these shales yield considerable amounts of shale oil when assayed. One hundred forty samples from 37 shale units were tested for potential oil recovery. Fischer assay results indicate yields ranging from trace amounts to

23.3 gallons of oil per ton of shale. Differences in oil revovery are directly related to the type and amount of organic matter within a shale. Vitrinite is the dominant maceral in the Upper Cretaceous and Pennsylvanian dark shales tested. The Lower Permian and Upper Ordovician shales are essentially devoid of any organic material. The Devonian-Mississippian Chattanogga Shale contains equally small amounts of phytoplankton and vitrinite. Seven potentially economic, low-grade mixed oil shales are present in the Middle and Upper Pennsylvanian strata of eastern Kansas: the "V", Excello, Little Osage, Anna, Tacket Formation, Eudora, and Heebner shales. If shale oil, phosphate, uranium, and mineable coals were extracted concurrently from these units, extraction costs would be reduced and an economic window for potential exploitation of these oil shales might be formed. 47 refs., 3 figs., 6 tabs.

23504 **(SAND—85-0312) Clay identification and amount measured by laboratory techniques compared to well log responses: application to tight gas sands and shales.** Heinze, D.M. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010411.

Identification and amount of clay in tight sands and shales calculated by downhole log interpretation techniques have been compared with those measured by a variety of analytical laboratory methods. The US DOE's Multiwell Experiment in the Piceance Creek Basin, Colorado has provided a wide selection of core and extensive logging data from the Mesaverde Formation. The samples were analyzed for clay content in the laboratory using all of the following methods: optical petrography, x-ray diffraction, bulk chemical, acetate method for cation exchange capacity, sedigraph, pipet, and centrifuge. Potassium, uranium, and thorium (KUT) concentrations were determined utilizing the following techniques: x-ray fluorescence, atomic absorption, neutron activation, gamma spectroscopy and alpha spectrometry. This multiple technique approach was used in order to corroborate laboratory data. The results clearly show that relying on one or two methods can result in significant error. Laboratory data point out that this small sampling of log-defined good sands and shales actually represents a variety of lithologies and compositions. Also, it is apparent that the log data and log-based interpretations of clay and KUT content in these samples are in significant disagreement with the laboratory-derived information. The KUT logs of the two service companies represented also yielded different clay types based on the Th/K ratios. The results put forth in this study point out some of the difficulties in accurately making the calibrations commonly used in interpreting the clay quantity of a given interval. Two apparently identical gamma ray responses may represent two fairly different mineral compositions or distributions. Core analysis is necessary in order to accurately apply logging interpretations in a formation of this type. 30 references, 4 figures, 8 tables.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 23509

23505 **Chemical evaluation of product oils from two in-situ tar sand oil recovery projects.** Thomas, K.P.; Dorrence, S.M. (Dept. of Energy, Laramie Energy Technology Center, P.O.B. 3395, Laramie, WY 82071). pp 836-843 of The future of heavy crude and tar sands. Meyer, R.F.; Olson, J.C.; Wynn, J.C. New York, NY; McGraw-Hill, Inc. (1984). (CONF-8202102—).

From 2. international conference on future of heavy crude and tar sands; Caracas, Venezuela (7 Feb 1982).

The chemical and physical properties of the oil produced during the reverse/forward-combustion project (Product oil (TS-2C) are significantly improved in fuel quality with respect to the original bitumen. Significant reductions were noted for the following properties: pour point; specific gravity; percentages of wax, carbon residue, and nickel; and the percentage of residue boiling above 538°C. In addition, some properties of the product oil from TS-2C compared quite closely with those of a visbroken bitumen obtained from the same deposit. Thus, it was concluded that during the in-situ combustion process, the bitumen had, in general, undergone changes similar to those occurring during a mild thermal cracking process. However, when the chemical and physical properties of the oil produced during the steamflood project (TS-1S) are compared with those of the bitumen sample, it is noted that the oil produced by this process is very similar to the original bitumen. Of the 15 chemical and physical properties measured, only four (specific gravity and percentages of polar aromatics, nitrogen and nickel) deviate to the extent of two standard deviations from that value determined for the bitumen. Only the weight percentage of carbon residue varied significantly from that of the bitumen. Consequently, it was concluded that the TS-1S oil flowed into the production wellbores by the action of a hot-water flood.

23506 **Simulation study of the LETC TS-2C in situ combustion test in Utah Tar Sands.** Hutchinson, H.L.; Johnson, L.A.; Spivak, A. *Society of Petroleum Engineers of A.I.M.E. (American Institute of Mining, Metallurgical and Petroleum Engineers), Paper;* No. SPE-8395, vp(1979). (CONF-790913—).

From 54. annual SPE technical conference and exhibition; Las Vegas, NV, USA (23 Sep 1979).

From August 1977 through February 1978 the Laramie Energy Technology Center (LETC) of the US Department of Energy conducted an in situ combustion field test, designated LETC TS-2C, on a tar sand deposit near Vernal, Utah. A mathematical model study was subsequently conducted to match the performance of this test to help interpret the effects of field parameters and operating procedure upon the test and answer certain questions that arose about the test and thus help refine the design and operation of any possible future tests. The study was conducted using a multi-dimensional in situ combustion model, to attempt to calculate the field performance using the normal history matching procedure. Most of the questions posed could be answered by modeling only a portion of the experiment to allow finer definition of the reservoir. Most of the questioned phenomena also were observed in this quadrant.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 23503, 23505

23507 **Physical behaviour of oil shale at various temperatures and compressive loads. 2. Thermal expansion under various loads.** Duvall, F.E.W.; Pitt, C.H.; Sohn, H.Y. (Univ. of Utah, Salt Lake City, UT). *Fuel;* 64: No. 2, 184-188(Feb 1985).

The thermal expansion of oil shale for various applied compressive loads, grades and orientations of the bedding plane to the applied load have been measured. It was determined that increasing the compressive load decreases the maximum expansion. Under loads <4.827 MPa the expansions of oil shale specimens with perpendicular and parallel orientations increased with grade. Under loads of 0.345-4.827 MPa increasing the grade decreased the expansion of 45° orientated specimens.

0407 Health And Safety

23508 **The relationship of applied industrial hygiene programs and environmental toxicology studies.** Holland, L.M.; Jackson, J.O. (Los Alamos National Laboratory, Los Alamos, NM). pp 226-241 of Oil Shale: The Environmental Challenge III. Petersen, K.K. Golden, CO; Colorado School of Mines Press (1983). (CONF-820892—).

From Oil Shale Task Force conference; Vail, CO, USA (9 Aug 1982).

This paper discusses the relationship of an applied industrial hygiene program for oil shale processing and related experimental toxicology studies. Industrial hygiene programs are based on appropriate knowledge of the substances present in the workplace and the likelihood of worker exposure. Topics considered include mining, retorting, refined products, field studies, commitment of management to health and safety, engineering design review, quality assurance, surveys, training programs, personal protective equipment, limited egress/confined space, emergency preparedness, recordkeeping, and the relationship of the industrial hygiene staff to other facility organizations. It is concluded that the use of engineer-

ing control procedures, an effective design review system, and knowledge gathered in the chemical and petroleum industries and in mining should result in few new and unique employee health hazard concerns for oil shale processing plants.

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 23512

23509 **(DOE/LC/10449—1762) Multi-method, multi-lab study of a tar sand water sample.** Ahern, J.J. (Wyoming Univ., Laramie (USA). Wyoming Water Research Center). Apr 1984. Contract AS20-80LC10449. 146p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85003373.

A multi-method, multi-lab study was conducted on a tar sand water sample to determine if standard analytical methods could provide precise and accurate data. The tar sand water sample was produced during steam injection of a tar sand deposit near Vernal, Utah. Each of the ten selected laboratories received eight replicate tar sand water samples. Each laboratory also received one sample diluted by 10% and spiked by 0.05 mg/1 phenols, and another sample diluted by 20% and spiked by 0.10 mg/1 phenols. These last two samples were included for two reasons. First, they tested a laboratory's ability to measure accurately changes in sample concentrations. Second, they tended to disguise the similarities among the eight replicates. Forty-one analytical methods used to analyze 14 constituents were investigated in this project. The analytical methods and constituents are listed in Table I-1. One of the objectives of this project was to compare the performance of standard analytical methods in the analysis of tar sand waters and oil shale waters. Within-lab precision was considerably better when the methods were used in the analysis of tar sand waters. Between-lab precision was considerably poorer than within-lab precision in the analysis of both types of waters. Inaccuracies appeared to be greater in the analysis of oil shale waters. The second objective of this project was to identify those methods with poorer precision and accuracy in the analysis of tar sand waters so that future efforts could be focussed on these methods. The results on precision and accuracy are summarized in Table I-1. It is recommended that future efforts be focussed on the methods for boron, iron, manganese, and ammonia in order to identify and overcome the problems with imprecision and inaccuracy. 15 refs., 14 fig., 12 tabs.

23510 **Assessing the effects of oil shale facilities on water quality: critique and alternatives.** Bergman, H.L.; Meyer, J.S.; Sanchez, D.A. (Univ. of Wyoming, Laramie, WY). pp 110-117 of Oil Shale: The Environmental Challenge III. Petersen, K.K. Golden, CO; Colorado School of Mines Press (1983). (CONF-820892—).

From Oil Shale Task Force conference; Vail, CO, USA (9 Aug 1982).

This paper criticizes a proposal for a risk analysis on the environmental impact of wastewater releases from oil shale facilities. Data on the toxicity of untreated and treated oil shale wastewater streams are reviewed and an alternative to or an adjustment in the proposed risk analysis strategy is suggested. The quantity of risk in the proposal is determined by the equation Risk= Frequency x Severity. The severity factor is defined as the amount of wastewater that is discharged or otherwise abnormally handled. Some of the assumptions in the proposed risk analysis strategy are found to be misleading, particularly those assuming no backup process units, retort shutdown feasibility, conventional water treatment ineffectiveness, and that facilities will be "zero discharge". It is concluded that the proposed risk analysis strategy could not be used reliably to estimate the environmental impacts of unscheduled wastewater releases.

23511 **Oil shale solid waste disposal: Estimation of embankment physical stability and the movement of water solutes.** Wildung, R.E.; Bond, F.W.; Gee, G.W.; Nelson, J.D. (Pacific Northwest Lab., Richland, WA). pp 38-64 of Oil shale: The environmental challenges III. Petersen, K.K. Golden, CO; Colorado School of Mines Press (1983). (CONF-820892—).

From Oil Shale Task Force conference; Vail, CO, USA (9 Aug 1982).

This paper briefly reviews the basic principles governing the physical stability and the movement of water in a retorted shale embankment. The basic principles are incorporated in a hydrologic model and are used for the estimation of water movement in a conceptual embankment subjected to a hypothetical, simplified construction and closure scenario, and 30-year climatic exposure. The benefits and limitations of this approach are described in conjunction with research required to achieve more precise estimates of physical stability, and water and solute movement. Topics considered include embankment hydrology, unsaturated water flow, unsaturated flow modeling, embankment hydrology and climate, embankment configuration and properties, and the simulation of water movement. The described unsaturated flow model simulates precipitation and evaporation on an hourly basis and predicts infiltration rates with residence time in the environment for different embankment configurations, different material types with different initial water contents, different construction scenarios, and different climatic and boundary conditions.

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 23510, 23511

23512 **Oil shale: The environmental challenges III.** Petersen, K.K. Golden, CO; Colorado School of Mines Press (1983). 261p. (CONF-820892—). Publications Center, Golden, CO 80401.

From Oil Shale Task Force conference; Vail, CO, USA (9 Aug 1982).

This book presents the papers of a symposium whose purpose was to discuss the environmental and socio-economic aspects of oil shale development. Topics considered include oil shale solid waste disposal, modeling spent shale disposal, water management, assessing the effects of oil shale facilities on water quality, wastewater treatment and use at oil shale facilities, potential air emissions from oil shale retorting, the control of air pollutant emissions from oil shale facilities, oil shale air emission control, socio-economic research, a framework for mitigation agreements, the Garfield County approach to impact mitigation, the relationship of applied industrial hygiene programs and experimental toxicology programs, and industrial hygiene programs.

05 NUCLEAR FUELS

0501 Reserves

23513 **(PNCT-N—433-83-01) Present status of development of uranium resources in foreign countries.** (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Oct 1983. 275p. (In Japanese). NTIS (US Sales Only), PC A12/MF A01. File Number DE85700890.

The book with the same title as this was published in 1981. Thereafter, the necessity to correct the contents arose, such as the remarkable change in uranium market condition and the change of uranium resource policy in Australia accompanying the change of regime. Accordingly, the revision was carried out by adding more new information. As the main sources of the information collected in this book, 25 materials are shown. The confirmed resources of uranium in the free world as of the beginning of 1981 amounted to 2,293,000 t U, and the estimated additional resources were 2,720,000 t U. The political system and uranium policy, the present status of uranium export, the quantity of resources and the estimated amount of deposits, the uranium production and the status of uranium exploration and development of 25 foreign countries are reported. Japan has carried out uranium development activities in Australia, Canada, Niger, Gabon, Zambia and so on.

0502 Exploration

23514 (INIS-mf—9490) Uranium exploration, mining and the nuclear fuel cycle. Dickie, G.B. (ed.). (Chamber of Mineral Resources of Nova Scotia, Halifax (Canada)). May 1982. 82p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85780851.

The object of this paper is to summarize the nuclear industry in an understandable and systematic manner. The authors conclude that: (a) Uranium exploration can be carried out in an environmentally safe manner. (b) Uranium mining is being carried on currently in Canada in an environmentally and socially acceptable manner with many benefits accruing to the local population near the mine. (c) Uranium tailings can be properly handled utilizing modern technology both in the short term and the long term. (d) It is generally agreed by the majority of the scientific community that radiation protection standards adequately protect both nuclear workers and the general public. (e) Nuclear and coal-fired electrical generating plants can both supply base load energy supplies in the short and long term. In some jurisdictions it is the nuclear system which can provide the lowest cost energy supply. It is important that this option not be lost, either as a potential source of electrical energy domestically or as an export commodity.

0503 Mining

REFER ALSO TO CITATION(S) 23514, 23534

23515 (PB—85-145902/AS) Technique for in situ leach simulation of uranium ores. Grant, D.C.; Seidel, D.C.; Nichols, I.L. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Jan 1985. 61p. (OFR—192-80). NTIS, PC A04/MF A01. File Number TI85901320.

In situ uranium mining offers the advantages of minimal environmental disturbance, low capital and operating costs, and reduced mining development time. It is becoming an increasingly attractive mining method for the recovery of uranium from secondary ore deposits. In order to better understand the process, a laboratory technique was developed and used to study and simulate both the chemical and physical phenomena occurring in ore bodies during in situ leaching. The laboratory simulation technique has been used to determine effects of leaching variables on permeability, uranium recovery, and post-leach aquifer restoration. This report describes the simulation system and testing procedure in sufficient detail to allow the construction of the system, and to perform the desired leaching tests. With construction of such a system, in situ leaching of a given ore using various leach conditions can be evaluated relatively rapidly in the laboratory. Not only could optimum leach conditions be selected for existing ore bodies, but also exploitation of new ore bodies could be accelerated. 8 references, 8 figures, 2 tables.

23516 Review of the status of the US domestic uranium mining and milling industry. Hearing before the Subcommittee on Energy Research and Development of the Committee on Energy and Natural Resources, United States Senate, Ninety-Eighth Congress, Second Session, September 12, 1984. Washington, DC; Government Printing Office (1985). 402p.

Twelve witnesses spoke at a hearing examining a comprehensive review of the uranium mining and milling industry prepared by DOE and the Energy Information Administration. At issue was the questionable viability of the uranium industry and DOE's role in establishing policies which may have been counterproductive. Foreign competition has seriously eroded markets, partly because of a substantial cost advantage. The report found production, employment, capital investment, and exploration expenditures at historically low levels, with only 12 of the 23 mills operating, and these at only 58% of capacity. Uranium prices in 1983 continued a decline which began in 1976. Responding to the report's findings were representatives of the uranium industry, labor, the mining industry, and government officials. Two appendices with responses to additional questions and material submitted for the record follow their testimony.

0504 Feed Processing

REFER ALSO TO CITATION(S) 23516, 23534

23517 (INIS-mf—9493) Economic evaluation of preconcentration of uranium ores. Final report. (Lummus Canada Inc., Willowdale, Ontario). Apr 1981. 56p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780850.

Work conducted under the auspices of the Canada Centre for Mineral and Energy Technology.

The economics of two options for the preconcentration of low-grade uranium ores prior to hydrochloric acid leaching were studied. The first option uses flotation followed by wet high-intensity magnetic separation. The second option omits the flotation step. In each case it was assumed that most of the pyrite in the ore would be recovered by froth flotation, dewatered, and roasted to produce sulphuric acid and a calcine suitable for acid leaching. Savings in operating costs from preconcentration are offset by the value of uranium losses. However, a capital saving of approximately 6 million dollars is indicated for each preconcentration option. As a result of the capital saving, preconcentration appears to be economically attractive when combined with hydrochloric acid leaching. There appears to be no economic advantage to preconcentration in combination with sulphuric acid leaching of the ore.

23518 (PNCT-N—441-83-03) Development of uranium milling and conversion. Takada, Shingo; Hirono, Shuichiro. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Nov 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700881.

The development and improvement of uranium milling and refining producing uranium tetrafluoride from ores by the wet process, without producing yellowcake as an intermediate product, have been carried out for over ten years with a small pilot plant (50 t-ore/day). In the past several years, a process for converting uranium tetrafluoride into hexafluoride has been developed successfully. To develop the process further, the construction of an integrated milling and conversion pilot plant (200 t-U/year) started in 1979 and was completed in 1981. This new plant has two systems of solvent extraction using tri-noctylamine: one of the systems treats the pregnant solution (uranyl sulphate) by heap-leaching followed by ion exchange, and the other treats the uranyl sulphate solution by dissolving imported yellowcake. The uranium loading solvents from the two systems are stripped with hydrochloric acid solution to obtain the concentrated uranium solution containing 100 g-U/l. Uranyl sulphate solution from the stripping circuit is reduced to a uranous sulphate solution by the electrolytic method. In a reduction cell, uranyl sulphate solution and dilute sulphuric acid are used respectively as catholyte and anolyte, and a cation exchange membrane is used to prevent re-oxidation of the uranous sulphate. In the following hydrofluorination step, uranium tetrafluoride, $UF_4.1$-$1.2H_2O$ (particle size: 50-100μ), is produced continuously as the precipitate in an improved reaction vessel, and this makes it possible to simplify the procedures of liquid-solid separation, drying and granulation. The uranium tetrafluoride is dehydrated by heating to 350°C in an inert gas flow. The complete conversion from UF_4 into UF_6 is achieved by a fluidized-bed reactor and a high value of utilization efficiency of fluorine, over 99.9 percent, is attained at about 400°C.

0505 Enrichment

23519 (DOE/ER/10275—1C, pp 1, Paper 52) Uranium enrichment: the US Gas Centrifuge Program. Stanislaw, R.E. (Virginia Univ., Charlottesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The fundamental concepts of separating uranium isotopes by a gas centrifuge process are described. A general history of the United States' program is presented from Dr. Jesse W. Beams original work at the University of Virginia in 1934, to today's full scale gas centrifuge enrichment plant (GCEP) in Portsmouth, Ohio. Current US program activities, which involve various government R &

D contractors, are summarized. Comparisons are provided between the present gaseous diffusion method of enrichment and the gas centrifuge process.

23520 (DOE/ER/10275—1C, pp 1, Paper 54) **Laser isotope separation: an overview.** Reese, R.T. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

This paper is an overview of the laser method for separating isotopes of uranium. Emphasis is given to technique, hardware and economics of the method developed by Jersey Nuclear Isotope Avco (JNIA) Corporation, as revealed by their reports and patents.

23521 (DOE/OT/21400—T2) **Advanced uranium enrichment technologies.** Merriman, R. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 10 Mar 1983. Contract AC05-84OT21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010575.

Statement before the Committee on Science and Technology, Subcommittee on Energy Research and Production, US House of Representatives.

The Advanced Gas Centrifuge and Atomic Vapor Laser Isotope Separation methods are described. The status and potential of the technologies are summarized, the programs outlined, and the economic incentives are noted. How the advanced technologies, once demonstrated, might be deployed so that SWV costs in the 1990s can be significantly reduced is described.

23522 (UVA-ER—953-84U) **Unsymmetrical flow in a centrifuge .** Maslen, S.H. (Martin Marietta Labs., Baltimore, MD (USA)). Sep 1984. Contract AC05-82OR20900. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009021.

These notes discuss the differential equations for a centrifuge sector: a cylinder whose cross section is a slice of pie, presumably mud. Three boundary layers are considered: the cylindrical wall layer, Ekman layers at the ends, and the buoyancy layers on the θ = constant walls. T. Matsuda and K. Nakagawa consider most of the time that the cylinder is infinitely long, and all of the time that the atmospheric scale height is of the order of the bowl radius. Both restrictions are relaxed herein. 2 references.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 24188

23523 (PNCT-N—831-82-01, pp 72-75) **Design of the plutonium-uranium co-conversion facility.** Tamura, Takeo; Oshima, Hirofumi; Hirayama, Masaaki; Murayama, Satoshi (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Sep 1982. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780801.

Published in summary form only.

In Annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. April 1981-March 1982.

23524 (PNCT-N—831-82-01) **Annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. April 1981-March 1982.** Nakajima, Kentaro. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Sep 1982. 178p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780801.

Separate abstracts were included for each paper. (MOW)

23525 **Gas tungsten arc welder with electrode grinder.** Christiansen, D.W.; Brown, W.F. (to Dept. of Energy). US Patent 4,480,171. 30 Oct 1984. Filed date 30 Nov 1982. vp. PAT-APPL-445604.

A welder for automated closure of fuel pins by a gas tungsten arc process is claimed. A rotating length of cladding is positioned adjacent a welding electrode in a sealed enclosure. An independently movable axial grinder is provided in the enclosure for refurbishing the used electrode between welds.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 24187, 24188

23526 (JAERI-M—83-209) **Program of nuclear criticality safety experiment at JAERI.** Kobayashi, Iwao; Tachimori, Shoichi; Takeshita, Isao; Suzaki, Takenori; Ohnishi, Nobuaki. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700882.

JAERI is promoting the nuclear criticality safety research program, in which a new facility for criticality safety experiments (Criticality Safety Experimental Facility : CSEF) is to be built for the experiments with solution fuel. One of the experimental researches is to measure, collect and evaluate the experimental data needed for evaluation of criticality safety of the nuclear fuel cycle facilities. Another research area is a study of the phenomena themselves which are incidental to postulated critical accidents. Investigation of the scale and characteristics of the influences caused by the accident is also included in this research. The result of the conceptual design of CSEF is summarized in this report.

23527 (ORNL/TM—9256) **Cleanup of Savannah River Plant solvent using solid sorbents.** Mailen, J.C.; Tallent, O.K. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010592.

The degradation products produced in Purex solvent by exposure to nitric acid and radiation can be divided into two groups: those which are removed by scrubbing with sodium carbonate solutions and those which are not; these latter materials are called secondary degradation products. This study investigated the use of solid sorbents for removal of the secondary degradation products from first-cycle Savannah River Plant solvent that had been previously washed with sodium carbonate solution. Silica gel, activated charcoal, macroreticular resin, attapulgite clay and activated alumina were the sorbents investigated in preliminary testing. Activated alumina was found to be most effective for improving phase separation of the solvent from sodium carbonate solutions and for increasing the interfacial tension. The activated alumina was also the sorbent most useful for removing complexants which retain plutonium at low acidity, but it was less effective in removing anionic surfactants and ruthenium. We found that the capacity of the activated alumina was greatly improved by drying the solvent before treatment.

23528 (ORNL/TM—9513) **Consolidated Fuel Reprocessing Program. Progress report, October 1-December 31, 1984.** Feldman, M.J.; Groenier, W.S.; Meacham, S.A.; Stradley, J.G. (Oak Ridge National Lab., TN (USA)). Feb 1985. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008750.

Improved processes and components for the Breeder Reprocessing Engineering Test (BRET) were identifed and developed as well as the design, procurement and development of prototypic equipment. The integrated testing of process equipment and flowsheets prototypical of a pilot-scale full reprocessing plant, and also for testing prototypical remote features of specific complex componets in the system are provided. Information to guide the long-range activities of the Consolidated Fuel Reprocessing Program (CFRP), a focal point for foreign exchange activities, and support in specialized technical areas are described. Research and development activities in HTGR fuel treatment technology are being conducted. Head-end process and laboratory-scale development efforts, as well as studies specific to HTGR fuel, are reported. The development of off-gas treatment processes has generic application to fuel reprocessing; progress in this work is also reported.

23529 (PNCT-N—831-82-01, pp 76-80) **Compositions and solubilities of Pu and U compounds in the product of the co-conversion process using the microwave heating method.** Kashiro, Kashio; Arishige, Tatsushi; Todokoro, Akio; Akiyama, Hideo (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Sep 1982. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780801.

In Annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. April 1981-March 1982.

The composition and solubility of Pu-U compounds produced by the microwave heating co-conversion process were experimentally studied. Three kinds of samples were prepared for the experiment: (1) three denitrated samples taken from different positions in one denitration vessel; (2) three samples which were denitrated and calcined for 1 hour at different temperature; (3) two sintered pellets with 30 % and 50 % PuO_2 concentration. The composition analysis of these samples was made by X-ray diffraction method. The dissolution test was performed by dissolving 10 grams of each sample in 200 ml of boiling nitric acid from 116 deg C to 118 deg C for 5 hours. The uranium compound in every sample completely dissolved in nitric acid, but the dissolution rate of the Pu compound was different according to the samples. It was found that the PuO_2 with poor crystallinity dissolved completely, and that the formation of a solid solution in the pellets (30 % PuO_2) had a good effect on the solubility, whereas the higher concentration of Pu (50 % PuO_2) brought about undesirable effect. It was also found that the solubility decreased with the progress of crystal growth of PuO_2.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 23542, 23544, 23562, 23837, 24198

23530 (EGG-TIO-M—00685) **TMI-2 spent fuel shipping.** Quinn, G.J.; Burton, H.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 3p. (CONF-850314—45). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009972.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

TMI-2 failed fuel will be shipped to the Idaho National Engineering Laboratory for use in the DOE Core Examination Program. The fuel debris will be loaded into three types of canisters during defueling and dry loaded into a spent fuel shipping cask. The cask design accommodates seven canisters per cask and has two separate containment vessels with "leaktight" seals. Shipments are expectd to begin in early 1986.

23531 (PNL—5384) **Spent nuclear fuel shipping cask handling capabilities of commercial light water reactors.** Daling, P.M.; Konzek, G.J.; Lezberg, A.J.; Votaw, E.F.; Collingham, M.I. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01830. 174p. (TTC—0535). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85010214.

This report describes an evaluation of the cask handling capabilities of those reactors which are operating or under construction. A computerized data base that includes cask handling information was developed with information from the literature and utility-supplied data. The capability of each plant to receive and handle existing spent fuel shipping casks was then evaluated. Modal fractions were then calculated based on the results of these evaluations and the quantities of spent fuel projected to be generated by commercial nuclear power plants through 1998. The results indicated that all plants are capable of receiving and handling truck casks. Up to 118 out of 130 reactors (91%) could potentially handle the larger and heavier rail casks if the maximum capability of each facility is utilized. Design and analysis efforts and physical modifications to some plants would be needed to achieve this high rail percentage. These modifications would be needed to satisfy regulatory requirements, increase lifting capabilities, develop rail access, or improve other deficiencies. The remaining 12 reactors were determined to be capable of handling only the smaller truck casks. The percentage of plants that could receive and handle rail casks in the near-term would be reduced to 64%. The primary reason for a plant to be judged incapable of handling rail casks in the near-term was a lack of rail access. The remaining 36% of the plants would be limited to truck shipments. The modal fraction calculations indicated that up to 93% of the spent fuel accumulated by 1998 could be received at federal storage or disposal facilities via rail (based on each plant's maximum capabilities). If the near-term cask handling capabilities are considered, the rail percentage is reduced to 62%.

23532 (PNL-SA—12663) **Spent fuel storage requirements.** Libby, R.A.; Cole, B.M. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 11p. (CONF-850314—56). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010304.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Long before a permanent nuclear waste disposal system is available in the United States, several of the operating commercial nuclear power plants will exhaust their existing spent fuel storage capabilities. Studies to define the magnitude of this interim problem were conducted by the Department of Energy through the Commercial Spent Fuel Management (CSFM) Program at the Pacific Northwest Laboratory. Based on information supplied by the nuclear utilities, these studies indicate that if new storage concepts are not available by 1986 some reactors could encroach on their storage pool's full core reserve (FCR), and ultimately, be forced to shutdown. 3 refs., 2 figs., 5 tabs.

23533 **System for handling and storing radioactive waste.** Anderson, J.K.; Lindemann, P.E. (to Dept. of Energy). US Patent 4,481,165. 6 Nov 1984. Filed date 19 Jul 1982. vp. PAT-APPL-399934.

A system and method for handling and storing spent reactor fuel and other solid radioactive waste is claimed, including canisters to contain the elements of solid waste, storage racks to hold a plurality of such canisters, storage bays to store these racks in isolation by means of shielded doors in the bays. This system also includes means for remotely positioning the racks in the bays and an access tunnel within which the remotely operated means is located to position a rack in a selected bay. The modular type of these bays will facilitate the construction of additional bays and access tunnel extension.

0510 Marketing And Economics

REFER ALSO TO CITATION(S) 23514, 23516, 23544, 23562

23534 (INIS-mf—9494) **[Uranium in the Wollaston Lake area]. Eldorado Nuclear Ltd., annual report, 1982.** (Eldorado Nuclear Ltd., Ottawa, Ontario (Canada)). 1983. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780853.

In 1982 Eldorado Nuclear Ltd. acquired important new sources of uranium in the Wollaston Lake area of northern Saskatchewan by purchasing the shares of Gulf Minerals Canada Ltd. and Uranerz Canada Ltd. Eldorado Nuclear Ltd. is now sole owner of the Rabbit Lake properties, consisting of more than 30 million kg of U_3O_8 and a mill with a capacity of 2.5 million kg annually. Production records were set at the Port Hope, Ontario, uranium processing plant, and processing capacity continued to expand there and at the new Blind River, Ontario, refinery. The uneconomic Beaverlodge mine in northern Saskatchewan was closed as scheduled. The company participated in the development of the Key Lake project in northern Saskatchewan. This high-grade, open pit mine has reserves containing more than 80 million kg of U_3O_8, and will have a production capacity of 5.4 million kg annually when production begins in 1983. Company assets were increased from $618.4 million in 1981 to $875.6 million in 1982; and corporate structure was re-organized to integrate newly-acquired operations. Earnings for 1982 were $4 million.

0520 Waste Management

REFER ALSO TO CITATION(S) 23533, 23581, 23582, 23587, 24115, 24155, 24296, 24445, 24446, 24447, 24449, 24450, 24451, 24452, 24453, 24457, 24461, 24462, 24463, 24473, 24474

23535 (AECL—7822, pp 231-260) **Potential for the disturbance of a buried nuclear waste vault by large-scale meteorite impact.** Grieve, R.A.F.; Robertson, P.B. (Brown Univ., Providence, RI). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

From observations on large earth-crossing, asteroidal-like and cometary bodies, and from the relative crater densities on young mare surfaces on the moon and the stable cratonic areas on earth, the terrestrial cratering rate is estimated to be 5.0 +/- 2.5 x 10^{-15} km^{-2} a^{-1}, for craters larger than 20 km in diameter. Analysis of the crater-forming process permits the identification of a number of potential effects of impact on the geosphere. These are ballistic excavation, local redistribution, large-scale displacement, large-scale fracturing, and seismic activation. The relative spatial relations of these effects are determined and allow calculation of the minimum-sized crater that could produce any specific effect on a vault designed to contain high-level nuclear waste, and buried at a depth of 1 km. Using a size-frequency distribution of N varies directly as D^{-2} for terrestrial craters, and the estimated cratering rate, the probability of these impact-induced changes affecting a vault is computed. For a time period of 10^6 a, probabilities of impact-induced changes are extremely low for the proposed vault geometries. For example, the probability of excavation and widespread redistribution of nuclear materials occurring is only 1.4 x 10^{-6}. Only in the case of seismic activations do probabilities approach 10^{-3}. Other impact-related changes to the terrestrial environment are discussed and it is concluded that they are equally unlikely to affect vault integrity. Given that any vault will be designed to withstand a certain amount of seismic activity, it is concluded that large-scale meteorite impact is probably not a significant parameter in considering long-term vault integrity.

23536 (BMI/ONWI—575) **Surface hydrologic characteristics of proposed repository locations in the Palo Duro Basin of the Texas Panhandle.** (NUS Corp., Gaithersburg, MD (USA)). Apr 1985. Contract AC02-83CH10140. 131p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85010530.

This report provides a description of the surface hydrology in the two proposed locations of a high-level waste repository within the Palo Duro Basin of the Texas Panhandle. Included for consideration are the topography; the major drainage systems - Palo Duro, Tierra Blanca, and Tule Creeks, and Prairie Dog Town Fork of the Red River; and the most prominent impoundments, the playa lakes. The magnitude and frequency of precipitation throughout the region are discussed, and rainfall depth-duration-area data for the 100-year, 500-year, and probable maximum storms are presented. Soil properties are also described, with specific reference to the infiltration and runoff processes and the contribution of these processes to Ogallala aquifer recharge. A summary discussion of the local streams includes information on historical streamflow, a brief description of flooding, and results of a study of floodplains for the 100-year, 500-year, and probable maximum storms. The report concludes with a characterization of the water quality of these streams and an explanation of the local geologic influences on stream-water chemistry. 25 figures, 20 tables.

23537 (CONF-841210—23) **TRU decontamination of high-level Purex waste by solvent extraction using a mixed octyl(phenyl)-N,N-diisobutyl-carbamoylmethylphosphine oxide/TBP/NPH (TRUEX) solvent.** Horwitz, E.P.; Kalina, D.G.; Diamond, H.; Kaplan, L.; Vandegrift, G.F.; Leonard, R.A.; Steindler, M.J.; Schulz, W.W. (Argonne National Lab., IL (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 1984. Contract W-31-109-ENG-38. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010251.

From International chemical congress of Pacific Basin Society; Honolulu, HI, USA (16 Dec 1984).

The TRUEX (transuranium extraction) process was tested on a simulated high-level dissolved sludge waste (DSW). A batch counter-current extraction mode was used for seven extraction and three scrub stages. One additional extraction stage and two scrub stages and all strip stages were performed by batch extraction. The TRUEX solvent consisted of 0.20 M octyl(phenyl)-N,N-diisobutyl-carbamoyl-methylphosphine oxide-1.4 M TBP in Conoco (C_{12}-C_{14}). The feed solution was 1.0 M in HNO_3, 0.3 M in $H_2C_2O_4$ and contained mixed (stable) fission products, U, Np, Pu, and Am, and a number of inert constituents, e.g., Fe and Al. The test showed that the process is capable of reducing the TRU concentration in the DSW by a factor of 4 x 10^4 (to <100 nCi/g of disposed form) and reducing the quantity of TRU waste by two orders of magnitude.

23538 (DOE/ER/10275—1C, pp 1, Paper 12) **Incineration: an alternative for disposal of liquid scintillation counting waste.** Salas, P. (Florida Univ., Gainesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The object of this work was to study incineration as an alternative for disposal of liquid scintillation counting waste (LSCW). The method selected used an existing commercial boiler as the incinerator. A portable injection unit (PIU) was developed that injected LSCW into the oil line of the burner. After minor modifications of the original design, a system was built that operated without instabilities in the operating boiler, and useful steam output was attained. The project proved that commercial boilers can be used for disposal of LSCW and other liquids. Only minor modifications of existing boiler systems are required, and the capital investment is almost trivial.

23539 (DOE/ER/10275—1C, pp 1, Paper 13) **Economic analysis for incineration of liquid scintillation counting waste.** Kaplan, G. (Florida Univ., Gainesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Burial of Liquid Scintillation Counting Waste (LSCW) is no longer a viable disposal technique. The disposal site located in South Carolina will no longer accept such liquids, and sites in Nevada and Washington will discontinue acceptance in this decade. The object of this work was to develop a safe, economical alternative method for disposing of LSCW. A portable injection unit (PIU) was developed to inject LSCW directly into existing boiler oil feed lines. Further work on construction and testing can be found in work done by Salas. The project proved that there exists a safe, economical alternative to burial for disposing of LSCW. A large savings in disposal cost can be obtained because the PIU acts as a compactor by disposing of the hazardous waste only. Additional savings are obtained in fuel cost by taking advantage of the LSCW's fuel worth. A complete economic analysis will be discussed.

23540 (DOE/ER/10275—1C, pp 1, Paper 14) **Various methods for solidification of high level nuclear waste.** Lapp, C.W. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

One of the major concerns for the nuclear industry today is an effective method of high level waste immobilization. Because of this, various methods to solidify and contain such wastes are examined. First, the problem and biological hazards of high level wastes are discussed. This includes the ways in which waste enters the biosphere and how its relative toxicity varies with time. Next, the various forms of waste solidification are presented. These include glass, ceramic, and synthetic rock encapsulation. Each one is tested for various physical properties which relate to the ability of that medium to contain nuclear substances. The capability of withstanding high irradiation over a long period of time without increasing its leech rate is particularly essential. Comparison of the different solidification processes is then discussed and conclusions drawn as to which method is most suitable.

23541 (DOE/LLW—42T) Use of compensation and incentives in siting low-level radioactive waste disposal facilities. (American Planning Association, Chicago, IL). Apr 1985. Contract AC07-83ID12461. 72p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010412.

This report assumes that local opposition is a critical issue in siting low-level radioactive waste disposal facilities. Although it recognizes the importance of local health and safety concerns, this report only addresses the economic issues facing local officials in the siting process. Finding ways to overcome local opposition through economic compensation and incentives is a basic step in the waste facility siting process. The report argues that the use of these compensation and incentive mechanisms can help achieve greater local acceptance of waste facilities and also help ease the economic burdens that many communities bear when they agree to host a low-level waste disposal facility. The growing national need for low-level radioactive waste disposal facilities requires that state and local planning agencies develop creative new procedures for siting facilities, procedures that are sensitive to local perceptions and effects.

23542 (DOE/NV/10250—18) Commercial Nuclear Waste Research and Development Program. Quarterly report, October-December 1984. (Westinghouse Electric Corp., Mercury, NV (USA). Waste Technology Services Div.). Mar 1985. Contract AC08-82NV10250. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008391.

Draft plans for shipping the fuel assemblies at E-MAD to the Idaho National Engineering Laboratory and subsequent closure of the E-MAD facility were prepared for DOE/NV in response to a request from DOE/HQ. All WTSD-Nevada Operations Quality Assurance administrative procedures were reviewed and updated, and new procedures were written to cover requirements of the Nevada Nuclear Waste Storage Investigations (NNWSI) Project Plan defined in the NNWSI Quality Assurance Plan. Collection of data on drywell storage of four canisterized fuel assemblies was concluded. Monthly gas samples were acquired to monitor the integrity of the fuel assembly utilized in the test. Gas samples were taken from the eight sealed canisters containing fuel assemblies (excluding B41). Contamination swipe samples were collected from the seven fuel assemblies being stored in unwelded canisters. Additional gas sampling of the canister containing fuel assembly B41 was initiated, at PNL request. This fuel assembly has been a suspected leaker since it was received at E-MAD in 1979.

23543 (DOE/OR/20722—5-Add.1) Engineering evaluation of alternatives for the disposition of the Weldon Spring Raffinate Pits Site. Addendum 1. (Bechtel National, Inc., Oak Ridge, TN (USA). Advanced Technology Div.). Apr 1985. Contract AC05-81OR20722. 151p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85010531.

This document is an addendum to the Engineering Evaluation of Alternative for the Disposition of the Weldon Spring Raffinate Pits Site (EEA), for the Weldon Spring, Missouri, US Department of Energy Surplus Facilities Management Program site (Bechtel National, Inc., 1984a). The purposes of this Addendum are: (1) to evaluate variations, or subalternatives, of the EEA Alternatives 3 and 4 that address the stabilization of the wastes at the Weldon Spring Raffinate Pits Site, the Weldon Spring Quarry, the vicinity properties, and possibly the Weldon Spring Chemical Plant and (2) to evaluate a new alternative that considers reprocessing the raffinates for additional uranium removal. Alternatives discussed in the EEA are briefly described in Subsection 2.1. The various subalternatives and the new alternative were developed in response to comments from Missouri state agencies and other reviewers of the EEA. The Environmental Impact Statement being prepared by Argonne National Laboratory will evaluate, as appropriate, all identified engineering alternatives (those presented in the EEA, this addendum, and others). The assessment of the six variations of alternatives previously evaluated in the EEA and the new alternative presented in this Addendum consisted of comparing them on the bases of engineering requirements, maintenance and surveillance requirements, cost, schedule, manpower requirements, and occupational radiation exposure.

23544 (DOE/RW—0025) Analysis of the total system life cycle cost for the Civilian Radioactive Waste Management Program: executive summary. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Apr 1985. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010971.

The total-system life-cycle cost (TSLCC) analysis for the Department of Energy's Civilian Radioactive Waste Management Progrram is an ongoing activity that helps determine whether the revenue-producing mechanism established by the Nuclear Waste Policy Act of 1982 is sufficient to cover the cost of the program. This report is an input into the third evaluation of the adequacy of the fee. The total-system cost for the reference waste-management program in this analysis is estimated to be 24 to 30 billion (1984) dollars. For the sensitivity cases studied in this report, the costs could be as high as 35 billion dollars and as low as 21 billion dollars. Because factors like repository location, the quantity of waste generated, transportation-cask technology, and repository startup dates exert substantial impacts on total-system costs, there are several tradeoffs between these factors, and these tradeoffs can greatly influence the total cost of the program. The total-system cost for the reference program described in this report is higher by 3 to 5 billion dollars, or 15 to 20%, than the cost for the reference program of the TSLCC analysis of April 1984. More than two-thirds of this increase is in the cost of repository construction and operation. These repository costs have increased because of changing design concepts, different assumptions about the effort required to perform the necessary activities, and a change in the source data on which the earlier analysis was based. Development and evaluation costs have similarly increased because of a net addition to the work content. Transportation costs have increased because of different assumptions about repository locations and several characteristics of the transportation system. It is expected that the estimates of total-system costs will continue to change in response to both an evolving program strategy and better definition of the work required to achieve the program objectives.

23545 (DP-MS—85-8) Structural design considerations for a radwaste processing facility. Foelber, S.C.; Sabbe, M.A. (Bechtel National, Inc., San Francisco, CA (USA). Advanced Technology Div.). 1985. Contract AC09-76SR00001. 13p. (CONF-850494—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009488.

From American Society of Civil Engineers spring meeting; Denver, CO, USA (29 Apr 1985).

The structural engineer needs to consider several criteria when designing a radioactive-waste processing facility in order to properly balance the requirements of safety and economy. This paper addresses the design criteria and structural design of a vitrification building and the special equipment and supports associated with remote process operations. In addition, approaches to construction, and the role of scale models to aid in engineering design and construction are discussed. 5 figures.

23546 (DPST—82-319) DWPF canister closure welding development program. Kelker, J.W. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 18 Feb 1982. Contract AC09-76SR00001. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010066.

The reference process for the final closure of the DWPF canister is upset welding which is a solid state welding process. The welding development program is currently in progress at TNX and will culminate in a full-scale demonstration of the canister closure process and definition of operating procedure and technical standard limits. This document describes in detail the welding development program.

23547 (DPST—84-439) High level caves rheological studies of tanks 15H, 42H, and 8F sludge/slurries. Hamm, B.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 11 Apr 1984. Contract AC09-76SR00001. 28p. (LP—10164). NTIS, PC A03/MF A01; GPO Dep. File Number DE85010063.

Samples of sludge were diluted to varying solids loading with salt-supernate, deionized water or pH 12 solution (0.01M

NaOH). Rheological and physical property determinations were made. There was not a large change in rheological properties of sludge following aluminum dissolution, and a dissolved solids contribution to yield stress was not observed. The tank 15/42 and GIW-79 sludges had aluminum concentrations from 14 to 28 wt %. The tank 8 and GIW-82 sludges had aluminum concentrations from 6 to 8 wt %. The high aluminum sludges showed a more rapid increase in yield stress as a function of insoluble solids than the low aluminum sludges. The synthetic sludge formulation used in the GIW-79 study was a fairly good match for tank 15/42 sludge and the GIW-82 formulation was a fairly food match for tank 8 sludge when comparing yield stress and consistency relationship to insoluble solids. The tank 15/42 results indicate a yield stress of about 200 dynes/cm^2 at 13 wt % insoluble solids. The tank 8 results show a yield stress of about 80 dynes/cm^2 at 19 wt % insoluble solids. The calculational procedure used yields a conservative upper limit on the value of yield stress. For sludge transfer from F to H-area (30 to 50 dynes/cm^2), the tank 8 sludge concentration range was 3 to 18 wt % insoluble solids. For transfer from H to S-area (30 to 100 dynes/cm^2), the tank 8 concentration range was 3 to 22 wt % insoluble solids and the tank 15/42 range was found to be 6 to 11 wt % insoluble solids.

23548 **(EGG-M—02585) Low-level waste incineration at the Idaho National Engineering Laboratory.** Gillins, R.L.; Davis, J.N.; Maughan, R.Y.; Logan, J.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 7p. (CONF-850314—51). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009678.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

A facility for the incineration of low-level beta/gamma contaminated combustible waste has been constructed at the Waste Experimental Reduction Facility (WERF) at the Idaho National Engineering Laboratory (INEL). The incineration facility was established to: (1) reduce the volume of currently generated contaminated combustible waste being disposed at the INEL's radioactive waste disposal site and thereby prolong the site's useful life; and (2) develop waste processing technology by providing a facility where full-size processes and equipment can be demonstrated and proven during production-scale operations. Cold systems testing has been completed, and contaminated operations began in September of 1984. Currently the facility is processing waste packaged in 2 x 2 x 2 ft cardboard boxes and measuring <10mR/h at contact. 3 figs.

23549 **(EGG-M—07885) DOE National Low-Level Waste Management Program: an overview.** Loughead, J.S.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 7p. (CONF-850314—52). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009679.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

This paper presents an overview of the National Low-Level Waste Management Program, both objectives and initiatives toward these objectives. For clarity, the program is considered from the context of Defense Program (DP) activities, and Nuclear Energy (NE) activities.

23550 **(EPRI-NP—3933) Installation and startup of the Palisades Nuclear Plant asphalt volume-reduction solidification system.** Miller, C.C.; Nelson, R.A.; Elguindy, H. (Sargent and Lundy, Chicago, IL (USA)). Mar 1985. 90p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $11.50. File Number TI85920576.

The first advanced volume reduction and solidification system (VRSS) to become operational in a nuclear power plant in the United States is the WasteChem Corporation system at Consumers Power Company's Palisades Plant. The WasteChem (formerly Werner and Pfleiderer Corp.) VRSS was retrofitted into the station and began processing radioactive waste in February 1984. This document is a progress report on the installation of and operating experience with this volume reduction system. The results of the startup testing that began in late 1982, the operating and processing parameters that were selected, and data on the performance of the system are presented. A discussion of the practical and theoretical aspects of the operation of the WasteChem system is included, along with a description of the process and the system. In addition, this report describes the previous solid radwaste systems, the decontamination of the radwaste building, and the installation of the system. Furthermore, information that was presented in previous EPRI reports on the status of volume reduction system developments is briefly updated in this report. 6 references, 33 figures, 11 tables.

23551 **(GAO/RCED—85-27) Department of Energy's initial efforts to implement the Nuclear Waste Policy Act of 1982.** Bowsher, C.A. (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 10 Jan 1985. 97p. General Accounting Office, Document Handling and Information Services Facility, P.O. Box 6015, Gaithersburg, MD 20760. File Number TI85901161.

Report to The Congress.

The Nuclear Waste Policy Act of 1982 establishes a comprehensive natinal program for the safe management, storage, and permanent disposal of highly radioactive materials accumulating at nuclear power plant sites. This report acknowledges progress the Department of Energy (DOE) has made in implementing major initial actions required by the act and discusses difficult challenges facing DOE in (1) meeting statutory schedules for the siting of nuclear waste disposal repositories, (2) assuring adequate program financing, and (3) enhancing management controls over repository planning and execution. Recommendations are made to the Secretary of Energy to reexamine program financing arrangements. 15 figs.

23552 **(GJ/TMC—14) Procedures for reconnaissance stream-sediment sampling.** Fleischhauer, H.L.; Engelder, P.R. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Feb 1985. Contract AC07-76GJ01664. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009789.

Stream-sediment sampling has been applied to environmental monitoring of radioactive pollution in streams since the early 1950s. The methods used have proven to be effective both in detecting the presence of pollution and in verifying that remedial measures have successfully reduced pollutant releases to streams. A simple grab-sampling procedure is recommended for reconnaissance-scale sampling conducted to detect the presence of radioactive pollutants; this procedure is based on methods used in the National Uranium Resource Evaluation, a program of the US Department of Energy Grand Junction Projects Office. For studies of the vertical distribution of radioactivity in stream sediments, a rapid, shallow coring procedure using PVC pipe is described. In addition to the recommended sampling procedures, a number of factors that may influence the results of a stream-sediment survey are briefly discussed in this report. These factors include particle size, temporal variation, and compositing of samples. 37 references, 2 figures, 2 tables.

23553 **(INIS-mf—9267) Chemical fundamentals of the application of aminopolyether 1.1.1. for tritium fixation for final storage purposes.** Carboo, D. (Hamburg Univ. (Germany, F.R.). Fachbereich Chemie). 11 Nov 1983. 192p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780849.

The chemical properties of APE 1.1.1. are studied with a view to its suitability for tritium fixation and for final storage purposes. For this purpose, the structure and properties of the free ligand and its protonation and tritiation products were described to begin with, followed by studies on the final storage characteristics of the tritiation products.

23554 **(INIS-mf—9491) Report of the National Technical Planning Group on Uranium Tailings Research.** Lapp, P.A. (National Technical Planning Group on Uranium Tailings Research, Ottawa, Ontario (Canada)). Sep 1981. 176p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780866.

The National Technical Planning Group on Uranium Tailings Research was formed in 1980 to review present activities and plan a research program on the management of wastes after a mine and mill have shut down. At present there are more than 100 million tonnes of uranium tailings on the surface in Canada. Most of these are under management; however, some 8 million tonnes have been abandoned completely. The group concluded that: 1) there

has been no systematic attempt to collect and organize the results of measurements already made on tailings; 2) there is an inadequate understanding of the processes that take place in tailings and in the pathways to the biosphere; 3) there is insufficient evidence on the extent of the long-term problem in the closeout of a uranium tailings basin; 4) there is a need to establish standardized measurement methodologies to improve the quality of data taken at different sites across Canada; 5) generic research and development on tailings disposal technology should be within the scope of a national program, whereas site-specific work is the purview of the mines and regulatory agencies; and 6) the uranium producers' contribution to the national tailings program should be their research on site-specific disposal alternatives. The first of these conclusions leads to the proposal to establish a national uranium tailings research program. The second suggests the need for a modelling program, the third and fourth for a national measurement program, and the remaining conclusions refer to disposal technologies research. The conclusions form the basis for a set of recommendations on uranium tailings research.

23555 **(INIS-mf—9492) Bench scale evaluation and economic assessment of ion exchange resins for the removal of radionuclides from uranium mill tailings effluents.** Lakshmanan, V.I.; Itzkovitch, I.J. (Eldorado Nuclear Ltd., Ottawa, Ontario (Canada)). Jul 1981. 47p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780865.

Work supported in part by the Canada Centre for Mineral and Energy Technology.

The removal of <0.45 m radium 226 (soluble) from acid and alkaline mill tailings effluents to meet the Canadian provincial (Ontario and Saskatchewan) objective of <3 pCi/L using ion exchange has been studied. Stirred tank tests were used to screen potential solid ion exchangers for detailed testing in columns. Column tests on selected exchangers were carried out to determine breakthrough curves as a function of column throughput. An economic assessment of the process was carried out. Results obtained indicate that removal of soluble radium 226 to <3 pCi/L by ion exchange is technically feasible. However, if the solid exchangers are to be used on a once through basis the process is prohibitively expensive.

23556 **(LBL—18451) Hydrothermal conditions and resaturation times in underground openings for a nuclear waste repository in the Umtanum flow at the Basalt Waste Isolation Project.** Pruess, K.; Bodvarsson, G. (Lawrence Berkeley Lab., CA (USA)). Jul 1982. Contract AC03-76SF00098. 137p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85010636.

Numerical simulation techniques have been used to study heat flow and pore fluid migration in the near field of storage tunnels and canister storage holes in a proposed high-level nuclear waste repository in the Umtanum Basalt at the Basalt Waste Isolation Project site at Hanford, Washington. Particular emphasis was placed on evaluating boiling conditions in the host rock. Sensitivity studies were performed to determine the influence of variations in critical site-specific parameters which are not presently accurately known. The results indicate that, even when rather extreme values are assumed for key hydrothermal parameters, the volume of rock dried by boiling of pore fluids is negligible compared to the volume of excavated openings. The time required for saturation of backfilling materials is thus controlled by the volume of the mined excavations. When realistic values for the parameters of the natural and man-made systems are used resaturation is predicted to occur within less than two years after backfilling is placed. The approximations used in the analyses, and their limitations, are discussed in the body of the report. Recommendations are made for additional studies of the thermohydrological behavior of a high-level nuclear waste repository. 31 references, 76 figures, 7 tables.

23557 **(NUREG/CP—0062) Application of geochemical models to high-level nuclear waste repository assessment: conference proceedings.** Jacobs, G.K.; Whatley, S.K. (eds.). (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 123p. (CONF-8410234—Summs.; ORNL/TM—9585). NTIS, PC A06/MF A01 - GPO. File Number TI85009817.

From Application of geochemical models to high-level nuclear waste repository assessment; Oak Ridge, TN, USA (2 Oct 1984).

A conference on the application of geochemical models in the assessment of high-level nuclear waste repositories was held to discuss the current status of geochemical code development, thermodynamic data bases, reaction kinetics, and coupled-process models as applied to site characterization and performance assessment activities. These proceedings include extended abstracts of the technical presentations given at the conference, a discussion of the role of geochemical modeling in predicting the performance of repositories, and a set of recommendations that identify the key developments needed in order for geochemical models to become more applicable for quantitative evaluations of repositories. Detailed recommendations relevant to the following subjects are discussed: (1) improved simulation of repository performance through inclusion of additional important geochemical processes and parameters into current geochemical models, (2) more careful attention to uncertainties associated with geochemical model calculations, (3) assigning priorities to (through sensitivity studies and critical evaluations) and then improving and/or obtaining important thermodynamic data, and (4) addressing the importance of kinetics in simulating repository behavior.

23558 **(ORNL/TM—8462) Flowsheets and source terms for radioactive waste projections.** Forsberg, C.W. (comp.). (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 141p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85009456.

Flowsheets and source terms used to generate radioactive waste projections in the Integrated Data Base (IDB) Program are given. Volumes of each waste type generated per unit product throughput have been determined for the following facilities: uranium mining, UF_6 conversion, uranium enrichment, fuel fabrication, boiling-water reactors (BWRs), pressurized-water reactors (PWRs), and fuel reprocessing. Source terms for DOE/defense wastes have been developed. Expected wastes from typical decommissioning operations for each facility type have been determined. All wastes are also characterized by isotopic composition at time of generation and by general chemical composition. 70 references, 21 figures, 53 tables.

23559 (PNCT-N—831-82-01, pp 107-115) **Chemical states of molybdenum in radioactive waste glass.** Ishiguro, Katsuhiko; Kawanishi, Nobuo; Nagaki, Hiroshi; Naito, Aritsune (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Sep 1982. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780801.

In Annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. April 1981-March 1982.

In order to confirm an expectation that the chemical state of molybdenum in glass reflects the phase separation tendency of the yellow solid from the melt of borosilicate glass, simulated waste glasses were prepared, and ESCA analysis was performed using a commercially available electron spectrometer (PHI550 E) with an excitation source consisting of Mg Kα-ray. The effects of the concentration of Mo and FE_2O_3 and the melting atmosphere (oxidizing or reducing) in which the samples were prepared on the chemical state of Mo and the solubility of MoO_3 were examined. From the observation of Mo spectra, it was shown that Mo in waste glass had several valencies, e.g., Mo(3), Mo(4), Mo(5) and Mo(6), while Mo in the yellow solid separated from the melts exhibited hexavalent state, the peak intensity of higher valencies increased relatively with the increase of MoO_3 concentration, but the chemical state of Mo did not change remarkably around the solubility limit of MoO_3, the melting atmosphere influenced on the Mo state in the waste glass, the peak intensity of Mo(6) increased relatively with the increasing Fe_2O_3 concentration, and Mo in devitrified glass exhibited hexa-valent state.

23560 (PNL—5394) High level radioactive waste vitrification process equipment component testing. Siemens, D.H.; Heath, W.O.; Larson, D.E.; Craig, S.N.; Berger, D.N.; Goles, R.W. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01830. 191p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85011143.

Remote operability and maintainability of vitrification equipment were assessed under shielded-cell conditions. The equipment tested will be applied to immobilize high-level and transuranic liquid waste slurries that resulted from plutonium production for defense weapons. Equipment tested included: a turntable for handling waste canisters under the melter; a removable discharge cone in the melter overflow section; a thermocouple jumper that extends into a shielded cell; remote instrument and electrical connectors; remote, mechanical, and heat transfer aspects of the melter glass overflow section; a reamer to clean out plugged nozzles in the melter top; a closed circuit camera to view the melter interior; and a device to retrieve samples of the glass product. A test was also conducted to evaluate liquid metals for use in a liquid metal sealing system.

23561 (PNL-SA—12545) Non-fuel hardware characterization: disposal concerns. Luksic, A.T.; McKee, R.W. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 6p. (CONF-850314—50). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010050.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

This paper presents the results of an investigation into the disposal requirements for the non-fuel-assembly components and the non-fuel pin hardware that will be generated during fuel consolidation that the Department of Energy (DOE) has contracted to accept for disposal. Radionuclide and material characteristics, and estimates of anticipated quantities are presented. Disposal options, applicable regulations, and cost estimates are also discussed.

23562 (PNL-SA—12649) Logistics analysis in support of DOE fee adequacy report. McNair, G.W.; Shay, M.R.; Wood, T.W.; Cashwell, J.W. (Pacific Northwest Labs., Richland, WA (USA); Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC06-76RL01830. 4p. (CONF-850314—48). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010055.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

The Nuclear Waste Policy Act of 1982 (Public Law 97-485) established a Nuclear Waste Fund to pay for the management and permanent disposal of commercial spent nuclear fuel and high-level radioactive waste in geologic repositories. The revenues for this fund come from a fee on electricity generated by nuclear power plants. The Act also established the Office of Civilian Radioactive Waste Management (OCRWM) within the Department of Energy (DOE) to administer the program for the management of commercial spent fuel and high-level waste. In managing this program, the DOE is required by the Act to determine annually whether the fee generates sufficient revenue to cover all costs. To support this determination, a series of analyses were performed to detail the anticipated cost that will be incurred to provide adequate transportation services within the waste management system. The analyses estimate the cost for providing transportation services between individual reactor sites and a repository. The "base case" scenarios investigate a two repository waste management system that is described in the draft DOE mission plan. Various geologic media combinations are investigated to provide a range of transportation costs that may be incurred. The results of the analyses are given as total transport cost (capital, maintenance, and shipping), description of fleet requirements (number and types of casks required), total transportation mileages, and required number of shipments. In addition, information is provided on the amounts of storage that will be required at individual sites and characteristics of the spent fuel that will be received at the various facilities throughout the waste management system.

23563 (PNL-SA—12940) Conceptual model for deriving the repository source term. Alexander, D.H.; Apted, M.J.; Liebetrau, A.M.; Doctor, P.G.; Williford, R.E.; Van Luik, A.E. (USDOE, Washington, DC; Pacific Northwest Labs., Richland, WA (USA); Weston (Roy F.), Inc., Rockville, MD (USA)). Nov 1984. Contract AC06-76RL01830. 13p. (CONF-841157—90). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010051.

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

Part of a strategy for evaluating the compliance of geologic repositories with federal regulations is a modeling approach that would provide realistic release estimates for a particular configuration of the engineered-barrier system. The objective is to avoid worst-case bounding assumptions that are physically impossible or excessively conservative and to obtain probabilistic estimates of (1) the penetration time for metal barriers and (2) radionuclide-release rates for individually simulated waste packages after penetration has occurred. The conceptual model described in this paper will assume that release rates are explicitly related to such time-dependent processes as mass transfer, dissolution and precipitation, radionuclide decay, and variations in the geochemical environment. The conceptual model will take into account the reduction in the rates of waste-form dissolution and metal corrosion due to a buildup of chemical reaction products. The sorptive properties of the metal-barrier corrosion products in proximity to the waste form surface will also be included. Cumulative releases from the engineered-barrier system will be calculated by summing the releases from a probabilistically generated population of individual waste packages. 14 refs., 7 figs.

23564 (PNL-SA—12970) Processing of high-level radioactive waste. McElroy, J.L. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 14p. (CONF-850419—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010058.

From 21. annual meeting of the National Council on Radiation Protection and Measurements; Washington, DC, USA (3 Apr 1985).

US research and development directed at solidifying both commercial and defense HLW has reached an advanced stage, and production facilities are being designed, constructed and operated. Defense HLW has been calcined and stored in granular form at the Idaho Falls National Laboratory since 1963. Three pilot-scale demonstration programs to solidify HLW have been conducted at the Pacific Northwest Laboratory with radioactive HLW. The Defense Waste Processing Facility is under construction at the Savannah River Laboratory, South Carolina; it will solidify the defense HLW at that site. Similar facilities are planned for the Hanford, Washington, and Idaho Falls, Idaho, sites to treat the HLW from defense programs. The Department of Energy is conducting a demonstration HLW solidification program at the West Valley, New York, site to prepare the HLW stored in onsite tanks for geologic disposal. After briefly describing liquid HLW storage, this paper discusses vitrification technology and the projects that will utilize the technology to solidify HLW at several locations.

23565 (SAND—81-1918) In Situ Tuff Water Migration/Heater Experiment. Final report. Johnstone, J.K.; Hadley, G.R.; Waymire, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 119p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85010415.

This report summarizes the results of the In Situ Tuff Water Migration/Heater Experiment operated in the welded portion of the Grouse Canyon Member of the Belted Range Tuff in U12g-tunnel (G-Tunnel) on the Nevada Test Site (NTS). The experiment was located approximately 400 m below the surface and 200 m above the water table in nearly saturated rock. The experiment was designed to provide an initial assessment of the thermally induced behavior of the potentially large volumes of water (~ 25 vol % in this case) available in saturated or nearly saturated tuffaceous rocks. Instruments in the water collection cavities, including water depth gages, pH probes, humidity gages, and pressure transducers measured some properties of the collected water. Other holes in the array were instrumented to measure temperature profiles, thermally

induced stress, and one provided a test bed for a continuously operating laser interferometer for measuring thermally induced rock displacements. Initial analysis of the water generation rate data in the heater hole, assuming a one-dimensional evaporation front/vapor diffusion model, provided good qualitative agreement. The results of chemical analyses of water samples supports the notion of mass transport by vapor diffusion in the heater hole but not in the water migration holes. Rock temperatures in the heater hole exceeded 240°C. The stress meters measured maximum radial and circumferential thermal stresses of 8.62 and 4.83 MPa respectively - approximately 40% of the pretest predicted values. The experiment with the laser interferometer was a failure. The results of the water migration experiment indicate that the pore water in these rocks was highly mobile, probably by a vapor diffusion/condensation process.

23566 **(SAND—84-1471) Fracture and matrix hydrologic characteristics of tuffaceous materials from Yucca Mountain, Nye County, Nevada.** Peters, R.R.; Klavetter, E.A.; Hall, I.J.; Blair, S.C.; Heller, P.R.; Gee, G.W. (Sandia National Labs., Albuquerque, NM (USA); Pacific Northwest Labs., Richland, WA (USA)). Dec 1984. Contract AC04-76DP00789. 184p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85009301.

The geological formations in the unsaturated zone at Yucca Mountain, on and adjacent to the Nevada Test Site (NTS), are currently being studied for consideration as the host for a radioactive-waste repository; the US Department of Energy is carrying out these studies through the Nevada Nuclear Waste Storage Investigations project. The formations are composed of tuffaceous (tuff) materials that must be evaluated to estimate the rate at which radionuclides would migrate to the accessible environment. According to the available evidence, the flux of water in the unsaturated zone beneath the Yucca Mountain site is low; quantifying such low flow rates through direct measurements is difficult. To help provide data that can be used to assess unsaturated flow, Pacific Northwest Laboratory (PNL), under contract to Sandia National Laboratories (SNL), performed hydrologic tests on tuffaceous samples from 48 different locations in Yucca Mountain. This report contains the entire set of psychrometer measurements of desaturation curves for tuffs from Yucca Mountain as well as a substantial number of saturated conductivity measurements. 19 references, 132 figures, 23 tables.

23567 **(SAND—84-1643) Version I of the users manual for the Tuff Data Base Interface.** Langkopf, B.S.; Satter, B.J.; Welch, E.P. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1985. Contract AC04-76DP00789. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85011180.

The Nevada Nuclear Waste Storage Investigations (NNWSI) project, managed by the Nevada Operations Office of the US Department of Energy, is investigating the feasibility of locating a repository at Yucca Mountain on and adjacent to the Nevada Test Site (NTS) in southern Nevada. A part of this investigation includes obtaining physical properties from laboratory tests on samples from Yucca Mountain and field tests of the in situ tuffs at Yucca Mountain. A computerized data base has been developed to store this data in a centralized location. The data base is stored on the Cyber 170/855 computer at Sandia using the System 2000 Data Base Management software. A user-friendly interface, the Tuff Data Base Interface, is being developed to allow NNWSI participants to retrieve information from the Tuff Data Base directly. The Interface gives NNWSI users a great deal of flexibility in retrieving portions of the Data Base. This report is an interim users manual for the Tuff Data Base Interface, as of August 1984. It gives basic instructions on accessing the Sandia computing system and explains the Interface on a question-by-question basis.

23568 **(SAND—85-0050C) Overview of the management of commercially generated radioactive waste.** Chu, M.S.Y.; Hunter, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-8506107—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009759.

From Society of Women Engineers conference; Minneapolis, MN, USA (27 Jun 1985).

Commercial nuclear-power plants have generated large volumes of high-level radioactive waste (HLW) since the late 1950s. These wastes are highly toxic and will remain so for thousands of years, necessitating a safe and permanent method of isolating the wastes from the biosphere. The Nuclear Waste Policy Act of 1982 requires that all HLW be permanently isolated in deep geologic repositories. While the Department of Energy (DOE) will design and construct the repositories, disposal will be governed by the regulatory criteria and standards of the Nuclear Regulatory Commission and the Environmental Protection Agency. This paper presents an overview of the disposal of nuclear waste in deep geological repositories.

23569 **(UCRL—91740) Corrosion performance of metals and alloys in a tuff geochemical environment.** Van Konynenburg, R.A.; McCright, R.D. (Lawrence Livermore National Lab., CA (USA)). 20 Mar 1985. Contract W-7405-ENG-48. 7p. (CONF-850314—40). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009449.

From Waste management '85; Tucson, AZ, USA (24 Mar 1985).

Reference and alternate alloy systems have been chosen for use in fabricating waste packages for a potential high-level nuclear waste repository in tuff. The main corrosion concerns have been identified. Testing performed to date indicates that austenitic stainless steels woul perform well as package materials under the expected conditions as well as the less likely extreme conditions so far postulated. Carbon steel appears to be adequate as a material for borehole liners. Copper-based alloys and Zircaloys are also undergoing corrosion testing, the former as alternate package materials, and the latter because of their presence as spent fuel cladding. 17 references, 2 tables.

23570 **(USGS-CIRC—904-A) Geologic and hydrologic characterization and evaluation of the Basin and Range Province relative to the disposal of high-level radioactive waste. Part I. Introduction and guidelines.** Bedinger, M.S.; Sargent, K.A.; Reed, J.E. (Geological Survey, Denver, CO (USA); Geological Survey, Alexandria, VA (USA)). 1984. 24p. US Geological Survey, 604 S. Pickett St., Alexandria, VA 22304. File Number TI85901310.

The US Geological Survey's program for geologic and hydrologic evaluation of physiographic provinces to identify areas potentially suitable for locating repository sites for disposal of high-level nuclear wastes was announced to the Governors of the eight states in the Basin and Range Province on May 5, 1981. Representatives of Arizona, California, Idaho, New Mexico, Nevada, Oregon, Texas, and Utah, were invited to cooperate with the federal government in the evaluation process. Each governor was requested to nominate an earth scientist to represent the state in a province working group composed of state and US Geological Survey representatives. This report, Part I of a three-part report, provides the background, introduction and scope of the study. This part also includes a discussion of geologic and hydrologic guidelines that will be used in the evaluation process and illustrates geohydrologic environments and the effect of individual factors in providing multiple natural barriers to radionuclide migration. 27 refs., 6 figs., 1 tab.

23571 **(USGS/WRI—82-4111) Geologic and well-construction data for the H-9 borehole complex near the proposed Waste Isolation Pilot Plant site, southeastern New Mexico.** Drellack, S.L. Jr.; Wells, J.G. (Geological Survey, Albuquerque, NM (USA). Water Resources Div.). 1982. Contract AI08-76DP00474. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010117.

The H-9 complex, a group of three closely spaced boreholes is located 5.5 miles south of the proposed Waste Isolation Pilot Plant (WIPP) site in east-central Eddy County, New Mexico. The holes were drilled during July, August, and September 1979 to obtain geologic and hydrologic data to better define the regional ground-water-flow system. The geologic data presented in this report are part of a site-characterization study for the possible storage of defense-associated radioactive wastes within salt beds of the Salado Formation of Permian age. The geologic data include detailed descriptions of cores, cutting, and geophysical logs. Each borehole was designed to penetrate a distinct water-bearing zone: H-9a (total depth 559 feet) was completed just below the Magenta Dolomite Member of the Rustler Formation; H-9b (total depth 708

feet) was completed just below the Culebra Dolomite Member of the Rustler Formation; H-9c (total depth 816 feet) was completed below the Rustler Formation-Salado Formation contact. The geologic units penetrated in borehole H-9c are eolian sand of Holocene age (0 to 5 feet); the Gatuna Formation of Pleistocene age (5 to 25 feet); and the Dewey Lake Red Beds (25 to 455 feet), the Rustler Formation (455-791 feet), and part of the Salado Formation (791 to 816 feet), all of Permian age. Three sections (484 to 501 feet, 615 to 625 feet, 692 to 712 feet) in the Rustler Formation penetrated by borehole H-9c are composed of remnant anhydrite (locally altered to gypsum) and clay and silt residue from the dissolution of much thicker seams of argillaceous and silty halite. This residue indicates that the eastward-moving dissolution within the Rustler Formation, found west of the WIPP site, is present at the H-9 site. 12 references, 2 figures, 7 tables.

23572 **Method of preparing nuclear wastes for transportation and interim storage.** Bandyopadhyay, G.; Galvin, T.M. (to Dept. of Energy). US Patent 4,482,481. 13 Nov 1984. Filed date 1 Jun 1982. vp.

PAT-APPL-383880.

Nuclear waste is formed into a substantially water-insoluble solid for temporary storage and transportation by mixing the calcined waste with at least 10 weight percent powdered anhydrous sodium silicate to form a mixture and subjecting the mixture to a high humidity environment for a period of time sufficient to form cementitous bonds by chemical reaction. The method is suitable for preparing an interim waste form from dried high level radioactive wastes.

23573 **Material bagging device.** Wach, C.G.; Brak, S.B.; Nelson, R.E. (to Dept. of Energy). US Patent 4,480,426. 6 Nov 1984. Filed date 19 Jan 1982. vp.

PAT-APPL-340625.

A bagging device for transferring material from one chamber through an opening in a wall to a second chamber includes a cylindrical housing communicating with the opening and defining a passage between the chambers. A cylindrical cartridge is slidably received within the housing. The cartridge has a substantially rigid cylindrical sleeve to which is affixed a pliable tube. The pliable tube is positioned concentrically about the sleeve and has a pleated portion capable of unfolding from the sleeve and a closed end extending over a terminal end of the sleeve. Sealing means are interposed in sealed relationship between the cartridge and the housing. Material from one chamber is inserted into the cartridge secured in the housing and received in the closed end of the tube which unfolds into the other chamber enclosing the material therein. The tube may then be sealed behind the material and then severed to form a bag-like enclosure defined by the tube's closed terminal end and the new seal. The new seal then forms a terminal end for the unsevered portion of the pliable tube into which additional material may be placed and the bagging process repeated.

23574 **Method for forming microspheres for encapsulation of nuclear waste.** Angelini, P.; Caputo, A.J.; Hutchens, R.E.; Jackey, W.J.; Stinton, D.P. (to Dept. of Energy). US Patent 4,481,134. 6 Nov 1984. Filed date 29 Jan 1982. vp.

PAT-APPL-343803.

Microspheres for nuclear waste storage are formed by gelling droplets containing the waste in a gelation fluid, transferring the gelled droplets to a furnace without the washing step previously used, and heating the unwashed gelled droplets in the furnace under temperature or humidity conditions that result in a substantially linear rate of removal of volatile components therefrom.

23575 **Solubility interpretations of leach tests on nuclear waste glass.** Strachan, D.M.; Krupka, K.M. (Pacific Northwest Laboratories, Richland, Washington). *Nuclear and Chemical Waste Management;* 5: No. 1, 87-99(1984).

A one-year leach test at 90°C was conducted on specimens of PNL 76-68 borosilicate glass, a simulated nuclear waste glass. The experimental method was MCC-1, one of the standard leach tests developed by the Materials Characterization Center (MCC). The leachant solutions included deionized water, a silicic acid/sodium bicarbonate solution, and a concentrated K-Mg-Na-Cl brine. Phase characterization techniques and geochemical codes were used to identify possible solubility and sorption controls for the constituents dissolved in the final leach solutions. In the non-brine solutions, an alteration layer of 30-50 μm is formed that consists mainly of an amorphous $Fe(OH)_3$. In addition, a zinc silicate phase precipitated on the glass surface and appears to control the concentrations of dissolved Cs and Si. Calculations with the MINTEQ geochemical code identified possible equilbrium solubility controls for dissolved Fe, Ca, Si, Zn, Pb, P, and F. These calculations also permitted an estimation of the pH at the temperature of the leach experiments. The PHREEQE geochemical code was used to predict the steady state concentrations of Ca^{2+} and Sr^{2+} in the final leachates by assuming their sorption on solid amorphous $Fe(OH)_3$. For the leach tests completed in the brine solution, a magnesium silicate phase precipitated on the glass surface and may have been responsible for the observed decrease in the concentration of the dissolved Si. This solid phase was tentatively identified as sepiolite and/or possibly talc. These results were compared to mineral solubilities calculated from the MINTEQ geochemical code.

23576 **Rutherford back scattering surface analysis of nuclear waste glasses after one year burial in STRIPA.** Hench, L.L.; Buonaquisti, A.D.; Spilman, D.B. (Ceramics Division, Department of Materials Science and Engineering, University of Florida, Gainesville, Florida). *Nuclear and Chemical Waste Management;* 5: No. 1, 75-85(1984).

Two simulated nuclear waste glasses, ABS-41 and ABS-39, with glass/glass, glass/bentonite, and glass/Pb burial interface configurations are examined by Rutherford Back Scattering (RBS) after a 1 year burial in deep granite boreholes (STRIPA mines, Sweden) at constant temperatures of 10°C and 90°C. RBS data analyses confirm the formation of a thin, silica-rich, reaction layer at the glass surface resulting from Na and B depletion due to ion-exchange between the glass and the surrounding media. Multiple valence cations concentrate within the silica-rich layer, with the exception of U, which is depleted from the surface region. Increases in burial temperature accelerate the extent of glass surface reactions as does wet, compacted bentonite at the interface. Pb interfaces precipitate Pb salts and $(x)PbOX(y)SiO_2$ reaction products at the glass surface.

23577 **The relevance of vapor phase hydration aging to nuclear waste isolation.** Bates, J.K.; Seitz, M.G.; Steindler, M.J. (Argonne National Laboratory, Argonne, IL). *Nuclear and Chemical Waste Management;* 5: No. 1, 63-73(1984).

The aging of nuclear waste glasses by vapor phase hydration is shown to be a process that: may occur under currently envisioned repository conditions; and causes significant alteration of the glass. This alteration results in large leach rate increases and radionuclide migration deviations when compared to results observed for unaged glass. Samples of both defense and commercial type glasses were aged to simulate long and short term repository storage. These aged glasses were then leached using MCC-1 and repository-oriented-analog type tests and the results were compared to similar tests done with unaged glass. It was found that actinide release from the aged glass was up to 185 times greater than from unaged glass. These results, coupled with anticipated surface storage and repository conditions in which glass/water vapor contact is possible under specific production and failure modes, suggest vapor phase hydration is an aging effect that should be addressed in long term release projections.

23578 **Technetium behavior in sulfide and ferrous iron solutions.** Lee, S.Y.; Bondietti, E.A. (Oak Ridge National Lab., TN). *Materials Research Society Symposia Proceedings;* 15: 315-322(1983). Contract W-7405-ENG-26.

Pertechnetate oxyanion ($^{99}TcO_4^-$), a potentially mobile species in leachate from a breached radioactive waste repository, was removed from a brine solution by precipitation with sulfide, iron, and ferrous sulfide at environmental pH's. Maghemite (γ-Fe_2O_3) and goethite (α-FeOOH) were the dominant minerals in the precipitate obtained from the TcO_4^--ferrous iron reaction. The observation of small particle size and poor crystallinity of the minerals formed in the presence of Tc suggested that the Tc was incorporated into the mineral structure after reduction to a lower valence state. Amorphous ferrous sulfide, an initial phase precipitating in

the TcO_4^--ferrous iron-sulfide reaction, was transformed to goethite and hematite (α-Fe_2O_3) on aging. The black precipitate obtained from the TcO_4^--sulfide reaction was poorly crystallized technetium sulfide (Tc_2S_7) which was insoluble in both acid and alkaline solution in the absence of strong oxidants. The results suggested that ferrous- and/or sulfide-bearing groundwaters and minerals in host rocks or backfill barriers could reduce the mobility of Tc through the formation of less-soluble Tc-bearing iron and/or sulfide minerals. 12 references, 2 figures, 2 tables.

23579 **Comparison of 200-liter and 40-milliliter leach tests.** Westsik, J.H. Jr.; Harvey, C.O.; Roberts, F.P.; Ross, W.A.; Thornhill, R.E. (Pacific Northwest Lab., Richland, WA). *Materials Research Society Symposia Proceedings;* 15: 243-249(1983). Contract AC06-76RL01830.

The authors conducted a modified MCC-1 leach test on a 145-kg block of a cast cement waste form. The leach vessel was a 200-liter Teflon-lined drum and contained 97.5 liters of deionized water. The results of this large-scale leach test were compared with the results of standard MCC-1 tests (40 ml) on smaller samples of the same waste form. The ratio of leachate volumes between the large- and small-scale tests was 2500 and the ratio of sample masses was 150,000. The cast-cement samples for both tests contained plutonium-doped incinerator ash. The leachates from these tests were analyzed for both plutonium and the matrix elements. Evaluation of plutonium plateout in the large-scale test indicated that the majority of the plutonium leached from the samples deposits onto vessel walls and little ($<3 \times 10^{-12}$M) remains in solution. Comparison of elemental concentrations in the leachates indicates some differences up to 5X in the concentration in the large- and small-scale tests. The differences are attributed to differences in the solubilities of Ca, Si, and Fe at pH $\sim$ 11.5 and at pH $\sim$ 12.5. The higher pH observed for the large-scale test is a result of the larger quantities of sodium in the large block of cement. 6 references, 3 figures.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 23514, 23536, 23552, 23557, 23563, 23576

23580 (DOE/ER/10275—1C, pp 1, Paper 15) **Migration of particulates in permeable rock columns.** Cropper, R.L. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The migration of radioactive material through soil and permeable rock formations have become a major topic of concern due to the interest in the licensing of new radioactive waste disposal sites. Previously, research has been conducted in relation to deep repositories; however, similar situations arise in the vadose zone, where there is a higher probability of naturally-occurring particulates of organic nature and for the incursion of water. Test data has provided information which suggests that particulates will travel through porous media subject to various delay mechnisms and must be included in any consideration of waste migration. Data concerning particulate migration must and should be considered in the future when radioactive waste disposal sites are licensed.

23581 **(SAND—84-0646) Research, progress and Mark A box model for physical, biological and chemical transports.** Robinson, A.R.; Marietta, M.G. (eds.). (Harvard Univ., Cambridge, MA (USA); Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 206p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85010574.

The second interim meeting focused on developing a new North Atlantic box model, with physical, biological, and geochemical components. The new model, called the Mark A, is a third-generation box model with 18 geographical compartments. Additional process compartments may be included as required by site characteristics. The model combines proven characteristics of predecessor models with new and more diverse routines. It may be driven by transport and distribution data derived from either physical observations or general circulation model (GCM) outputs. This is an important feature in that the new model, in addition to serving its primary purpose for radiological assessments, will also serve to integrate and consolidate both field observation programs and the GCM modeling programs. The GCM test problem has been satisactorily debugged and run to some 1700 y. Consequently, spun-up output from the US run will be circulated to all GCM participants (now including France) for prognostic and diagnostic test runs and intercomparisons. New and significant progress has occurred (1) in the development of techniques to embed high-resolution eddy-resolving models within coarser-grid GCM's and (2) in driving these combined systems with real-ocean data. This work is critical to the problem of realistic hazard assessment, and progress is therefore regarded as particularly noteworthy. Field work continues at the low-level dump sites in the eastern and western North Atlantic, and new long-term observation programs have been initiated for the Nares Abyssal Plain and Great Meteor East HLW study locations. A leapfrogging strategy is being used to increase efficiency and efficacy of field observation programs. Present model results are used to plan the next experiment, while results of the latest experiment are used to drive the next model runs.

23582 **(SAND—84-2087) Compilation of selected marine radioecological data for the US Subseabed Program: summaries of available radioecological concentration factors and biological half-lives.** Gomez, L.S.; Marietta, M.G.; Jackson, D.W. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 274p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85010828.

The US Subseabed Disposal Program has compiled an extensive objective concentration factor and biological half-life data base from the international marine radioecological literature. A microcomputer-based data management system has been implemented to provide statistical and graphic summaries of these data. The data base is constructed in a manner which allows subsets to be sorted using a number of interstudy variables such as organism category, tissue/organ category, geographic location (for in situ studies), and several laboratory-related conditions (e.g., exposure time and exposure concentration). This report updates an earlier review (SAND83-1725), and provides summaries of the tabulated data. In addition to the concentration factor/biological half-life data base, we provide an outline of other published marine radioecological works. Our goal is to present these data in a form that enables those concerned with predictive assessment of radiation dose in the marine environment to make a more judicious selection of data for a given application.

0540 Health And Safety

REFER ALSO TO CITATION(S) 23514, 23526, 23535, 23543, 24330

0550 Regulations

23583 **(LA—10243-MS) Automated instruments for in-line accounting of highly enriched uranium at the Oak Ridge Y-12 Plant.** Russo, P.A.; Strittmatter, R.B.; Sandford, E.L.; Stephens, M.M.; Brumfield, T.L.; Smith, S.E.; McCullough, E.E.; Jeter, I.W.; Bowers, G.L. (Los Alamos National Lab., NM (USA); Oak Ridge Y-12 Plant, TN (USA)). Feb 1985. Contract W-7405-ENG-36. 66p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010332.

Two automated nondestructive assay instruments developed at Los Alamos in support of nuclear materials accounting needs are currently operating in-line at the Oak Ridge Y-12 facility for recovery of highly enriched uranium (HEU). One instrument provides the HEU inventory in the secondary solvent extraction system, and the other monitors HEU concentration in the secondary intermediate evaporator. Both instruments were installed in December 1982. Operational evaluation of these instruments was a joint effort of Y-12 and Los Alamos personnel. This evaluation included comparison of the solvent extraction system inventories with direct measurements performed on the dumped solution components of the solvent extraction system and comparison of concentration assay results with the external assays of samples withdrawn from the process. The function and design of the instruments and detailed results of the operational evaluation are reported.

23584 **(LA—10306-MS) Compact L-edge densitometer for uranium concentration assay.** Brooks, M.L.; Russo, P.A.; Sprinkle, J.K. Jr. (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010344.

A new L-edge densitometer has been designed around a compact, commercial x-ray generator weighing less than 5 kg. The dc generator x-ray spectrum was tailored to produce a continuum of x-ray energies from 14 to 20 keV. The x rays were transmitted through uranium reference solutions, and the measured transmissions near the uranium L/sub III/-absorption edge were used to compute the uranium concentration assay result. The range of uranium concentrations in the reference solutions included 5 to 50 g/l. In this concentration range, the assay uncertainty for short count times and the flatness of the specific assay response were better than 0.5%. Thus, the precision and accuracy of this compact densitometer are equal to those demonstrated previously for the L-edge technique. The compact dimensions and optimized transmission geometry increase the practicality, versatility, and range of the L-edge applications. 12 references, 12 figures, 4 tables.

23585 **(NUREG—1065-Rev.1) Acceptance criteria for the low enriched uranium reform amendments. Revision 1.** Emeigh, C.W.; Gundersen, G.E.; Withee, C.J. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Apr 1985. 54p. NTIS, PC A04/MF A01 - GPO $4.50. File Number TI85901312.

Revisions have been made to the material control and accounting requirements for NRC licensees authorized to possess and use more than one effective kilogram of special nuclear material of low strategic significance to have MC and A systems able to (1) confirm the presence of special nuclear material, (2) resolve indications of missing material, and (3) aid in the investigation and recovery of missing material. This document presents criteria that can be used to aid in judging the acceptability of licensee plans that would be submitted to the NRC for implementing these capabilities. General performance objectives, system capabilities, and recordkeeping are addressed.

23586 **(UCID—20226) Safeguards management inspection procedures.** Barth, M.J.; Dunn, D.R. (Lawrence Livermore National Lab., CA (USA)). Aug 1984. Contract W-7405-ENG-48. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010624.

The objective of this inspection module is to independently assess the contributions of licensee management to overall safeguards systems performance. The inspector accomplishes this objective by comparing the licensee's safeguards management to both the 10 CFR, parts 70 and 73, requirements and to generally accepted management practices. The vehicle by which this comparison is to be made consists of assessment questions and key issues which point the inspector to areas of primary concern to the NRC and which raise additional issues for the purpose of exposing management ineffectiveness. Further insight into management effectiveness is obtained through those assessment questions specifically directed toward the licensee's safeguards system performance. If the quality of the safeguards is poor, then the inspector should strongly suspect that management's role is ineffective and should attempt to determine management's influence (or lack thereof) on the underlying safeguards deficiencies. (The converse is not necessarily true, however.) The assessment questions in essence provide an opportunity for the inspector to identify, to single out, and to probe further, questionable management practices. Specific issues, circumstances, and concerns which point to questionable or inappropriate practices should be explicitly identified and referenced against the CFR and the assessment questions. The inspection report should also explain why the inspector feels certain management practices are poor, counter to the CFR, and/or point to ineffecive management. Concurrent with documenting the inspection results, the inspector should provide recommendations for alleviating observed management practices that are detrimental to effective safeguards. The recommendations could include: specific changes in the practices of the licensee, followup procedures on the part of NRC, and proposed license changes.

23587 **Status of radioactive defense waste legislation.** Oertel, G.K. (Dept. of Energy, Washington, DC). *Proceedings of the National Council on Radiation Protection and Measurements;* No. 5, 261-263(1 Nov 1983). (CONF-830460—).

From 19. annual meeting of the National Council of Radiation Protection and Measurements; Washington, DC, USA (6 Apr 1983).

This paper addresses legislation on the management as opposed to the regulation of defense and civilian nuclear waste excluding mill tailings. In contrast to earlier legislation, the Nuclear Waste Policy Act of 1982 deals comprehensively with the storage and disposal of spent fuel and high-level waste from commercial sources, primarily from the nuclear power industry. One of the most important provisions of the Act may be the mechanism for resolving conflicts that are likely to develop between the national and local interests in the siting of waste facilities.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 24161

0702 Radiation Sources

23588 (DOE/ER/10275—1C, pp 1, Paper 44) **High intensity gamma source repair.** Westerman, J.P. (Lowell Univ., MA). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Laboratory work in the Nuclear Engineering and Radiation Health fields often requires the use of a high intensity gamma radiation source. If the mechanical system (used for placing a sample within the source geometry) breaks down, then a procedure utilizing remote manipulation of the mechanism, must be devised to effect a repair. This paper discusses one such repair that was performed in a hot cell at the University of Lowell.

23589 **(INS-TS—22) Report of the study meeting on fast monochromatic neutrons and their interdisciplinary use.** Nakamura, Naoji; Ishizaki, Yoshihide; Kosako, Toshiso. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jul 1983. 60p. (In Japanese). (CONF-8305246—1). NTIS (US Sales Only), PC A04/MF A01. File Number DE85700873.

From Meeting on fast monochromatic neutrons and their interdisciplinary use; Tanashi, Tokyo, Japan (30 May 1983).

A meeting on fast monochromatic neutrons and their interdisciplinary use was held on May 30, 1983. A proposal to install a fast monochromatic neutron source at the Institute for Nuclear Study, the University of Tokyo, was presented. The neutrons will be produced by the proton bombardment on a lithium target. Various experimental projects by using this neutron source and the experiences with fast neutrons were presented and discussed. The neutron spectra measured at this facility by using weak proton beam are shown. The experiences of fast neutron production at Tohoku University and at Japan Atomic Energy Research Institute are introduced. The problems associated to the reaction cross sections by fast neutrons are discussed from the viewpoint of nuclear chemistry. The methods to measure the production cross sections of long-lived nuclei by neutrons are presented. Other topics presented at this meeting are nuclear spallation reaction, the Fusion Material Irradiation Test Facility, new neutron-rich nuclei produced by fast neutron bombardment, the problems related to nuclear chemistry, shielding experiments with fast neutrons, and the neutron dosimetry for medical use.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 24190

23590 (EUR—9440-EN) Photoproduction of H_2 and NH_3 by the photosynthetic bacterium Rhodopseudomonas capsulata. Vignais, P.M.; Willison, J.C.; Colbeau, A.; Jouanneau, Y.; Madern, D.; Hallenbeck, P.C.; Thierry, J.P.; Renaud, M. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 29p. Commission of the European Communities, Luxembourg.

The photosynthetic bacterium, Rhodopseudomonas capsulata, exhibits a vigorous photoevolution of H_2 under certain conditions. The use of cultures, or immobilized cells, of this organism in a bioreactor, is therefore envisaged as a means of solar energy conversion. The purpose of the present research is to characterize physiologically, biochemically and genetically the H_2-evolving (nitrogenase) and H_2-uptake (hydrogenase) systems of R. capsulata in order to define the growth and reaction conditions and genetic characteristics, which are optimal for H_2-production. Finally, the use of whey as a cheap substrate for H_2-production has been evaluated. Assuming optimal rates of H_2-production, the estimated cost of H_2 produced by this system compares favourably with that of H_2 produced by electrolysis.

0806 Industrial And Commercial Use

REFER ALSO TO CITATION(S) 24199

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 24192

23591 (DOE/PC/70785—T1) Rate and selectivity enhancement in Fischer Tropsch synthesis. Quarterly research report. Gulari, E. (Michigan Univ., Ann Arbor (USA). Dept. of Chemical Engineering). 23 Mar 1985. Contract FG22-84PC70785. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008847.

We successfully demonstrated that concentration cycling of the feed improves selectivity and reactivity of ruthenium/alumina catalyst at moderate pressures (50 psig). Rate of reaction was improved by more than a factor of two compared to the equivalent steady state. We were also able to observe the reactive intermediate responsible for the enormous rate enhancements we had previously observed during CO oxidation on palladium. The surface concentration of this intermediate was found to correlate extremely well with the instantaneous rate of reaction. We have assembled a fast response quadrupole mass spectrometer for online selectivity measurements during the next phase of our research.

23592 (STEV-BF—84-16-Pt.1) Gasification of biomass and peat. Progress report phase 7 - 1983/07/01-1984/06/30. Sjoestroem, K. (Statens Energiverk, Stockholm (Sweden)). Sep 1984. 287p. (In Swedish). (KTR—84-19-Pt.1). NTIS (US Sales Only), PC A13/MF A01. File Number DE85751456.

Experimental studies on pyrolysis and gasification of peat, solid waste and biomass were initiated in late 1974 at the Royal Institute of Technology. In 1977 studies on secondary tar conversion were initiated, to investigate both the production of ethylene thermally and syngas and fuel gas catalytically. Detailed discussions of experimental methods and results from these studies have or will be published. The research has led to the development of an efficient gasification process for peat and biomass, the MINO-process. This process can be used, in an otherwise conventional process train, to generate methanol with a thermal efficiency of 54 percent. This figure is based on a feasibility study of a total self-supporting plant receiving biomass with a moisture content of 50 percent. The MINO-process is a three step process consisting of a fluidized bed, high temperature filter and a catalytical reformer. The operating pressure is 3.0 MPa mainly in order to avoid excessive compression work before the methanol synthesis, which is performed typically at 7.0 MPa. The different steps of the MINO-process have been studied in a bench scale unit at RIT, which has been in use since 1979. The process has been viewed as such a promising candidate for a possible methanol-from-biomass industry in Sweden that the Swedish government has funded SEK 22 M. (dollar 3.0 M) for the construction of a pilot plant and another SEK 27 M. (dollar 3.5 M) for the operation of this. This 12 ton/day pilot plant has been constructed by Studsvik Energiteknik AB and has recently been taken into operation. These papers summarizes some important research results, with emphasis on primary and secondary pyrolysis, and some aspects on their interpretation into gasification process design.

23593 (VTT-TUTK—252) Gasification of indigenous fuels. Part 3. Gasification experiments with milled peat and saw dust on a small fluidized bed reactor. Kurkela, E.; Filen, H.; Salo, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jan 1984. 44p. (In Finnish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751475.

Fluidization properties of wood and milled peat were determined in a model reactor made from transparent acrylic plastic. Gasification tests were made with a small laboratory scale fluidized bed reactor. Fluidization rates of saw dust and peat and quantities of fines removed from the bed were determined in a cold reactor. The fluidization rates proved clearly higher than those calculated. Particles are not fluidized as discrete particles but as conglomerates of particles. The gasification tests were carried out in a fluidized bed reactor with 150 mm inside diameter. Saw dust was found to be a readily gasifiable material. When dry saw dust was gasified, the heat value of gas was on average 5 MJ/msupsub(n). About 75% of the fed energy was recovered as gas. The proportion of discharged carbon material was 1-5% of the quantity of saw dust feed at the flow rate of 0.3-0.5 m/s. In the gasification of unscreened milled peat the corresponding discharge was 18-22%, which was equal to 20-30% of the energy of peat feed. The heat value of the product gas remained slightly lower than in wood gasification and even at best only 65% of the energy of peat feed was recovered as chemical energy and enthalpy of gas.

23594 Formation of gas-phase methyl radicals over MgO. Driscoll, D.J.; Martir, W.; Wang, J.X.; Lunsford, J.H. (Texas A and M Univ., College Station). *Journal of the American Chemical Society;* **107**: No. 1, 58-63(9 Jan 1985).

When methane was passed over MgO at temperatures of approximately 500°C, methyl radicals were produced on the surface, released into the gas phase, and trapped downstream in a solid argon matrix where they were analyzed by EPR spectroscopy. Significant differences in initial activity were observed, depending on whether the MgO was pretreated under vacuum or a flow of oxygen. Vacuum conditioning led to essentially no activity while oxygen conditioning resulted in substantial radical production. The oxidant of choice was also critical. Nitrous oxide resulted in a continuous decline of activity while in the presence of oxygen the formation of radicals was at a steady state. Doping of MgO with lithium, sodium, or iron was also examined. Lithium was found to greatly increase the activity up to a doping level of approximately 15.0 wt%. Two pathways are believed to be responsible for the radical formation. Over pure MgO, intrinsic cattion vacancies react with molecular oxygen to given an O^- center which can abstract a hydrogen atom from methane to produce the methyl radical. For the lithium-doped samples, substitutional Li^+ ions react with molecular oxygen to form a (Li^+O^-) center which is also capable of abstracting a hydrogen atom from methane. 28 references, 5 figures, 3 tables.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 23933

23596 (N—85-13068) Construction of a bacterium to convert cellulose to ethanol. Final report. Bellamy, W.D. (Cornell Univ., Ithaca, NY (USA)). Mar 1984. 58p. (TI—84-901639; NYSERDA—84-5). NTIS, PC A04/MF A01.

If the production of ethanol from biomass is to become viable on a commercial level, inexpensive and stable enzymes to digest cellulose (cellulases) must be available in relatively large quantities. Of the three enzymes required for the digestion of cellulose, Beta-glucosidase and/or cellabiase are the least heat stable and therefore the limiting step. The threefold purposes are: (1) select thermophilic actinomycetes producing high levels of Beta-glucosidase; (2) evaluate means for the harvesting and storage of cellulases produced from soluable substrates; and (3) isolate or produce new ethanol-producing thermophiles which are ethanol-tolerant.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 23461, 23993

23596 (DOE/CS/84003—T1) Continuous pyrolysis of biomass feedstocks in rotary kiln convertors. Technical evaluation of a cellulose waste converter at Jonesboro, Arkansas. Final report. Kimzey, J.R.; Hicks, H.H. Jr. (Arkansas Univ., Fayetteville (USA). Coll. of Engineering). 31 Jan 1985. Contract AC06-80CS84003. 60p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010133.

The primary objective of this work was to test and evaluate a rotary kiln pyrolytic wood waste convertor owned by the Angelo Industries of Jonesboro, Arkansas. More specifically the evaluation was directed to the evaluation of patented features of the Angelo kiln which concern the method of primary air injection into the kiln. Other items of interest were the throughput capacity of the kiln, the output of char and of combusible off gases.

23597 (SIND-PM—1983-9) Increased firing by means of forest products. New possibilities and consequences. (Statens Industriverk, Stockholm (Sweden)). 1983. 172p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85751471.

The effect of increased use of wood fuels on the supply of forest industry with timber has been investigated. The report presents a calculus of supply and an account of present and expected consumption. Recommendation for changed rules of supervision and control are presented. The proposals are kept inside the existing commissioning rules.

23598 (SLU-IVL—142) Importance of air drying for the storing property of fuel chips. Thoernqvist, T.; Gustafsson, G. (Sveriges Lantbruksuniversitet, Uppsala. Dept. of Forest Products). 1983. 86p. (In Swedish and English). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751408.

The purpose of the study presented here is to study the effect of cold air drying on fungus growth and matter loss during storage of chipped logging residuals. The study, which was carried out at Tensum, started in May 1981 and was concluded in February 1982. The logging residuals were collected on a logging area where the species mix in the standing forest was 20 percent pine, 70 percent spruce and 10 percent hardwoods. The material was chipped manually with a tractor-mounted chipper (type Poma 952 B). The chips were blown direct into four silos. Each was 26 m^3 in area, with a height of 2.0 m. The silos were placed on a cemented floor plate in a machine hall. Fans were connected to three of the silos. These were set so that the chips in the respective silos were thoroughly dried in 5, 13 and 32 days, respectively. The undried chips in the forth silod served as the reference control. At the start of study the average moisture content of the material varied between 27.4-32.9 percent. After the storage period the average moisture content had sunk to 17.5 percent in the material which had dried through for 5 days and 27.1 percent for the undried material. The average dry matter loss in the different silos was reduced drying time. During the storage period 1.7 percents energy increase was noted in the fuel chips which dried during the shortest period of time, while the other areas showed energy losses between 0.4 and 6.8 percent. The total fungal particles in the chips was $4x10^9$ per kg TS (dry matter) at the start of the study. During the storage period the total fungal spores increased by 1.5 to 7 times. After the storage period a reduction of 6 times was registered for the total viable fungal spores which grew in the material dried the shortest time. The greatest increase, 870 times was noted in the undried material.

23599 (SLU-IVL-U—130) Laboratory studies on the influence of chemical preparation on storered fuel chip properties. Thoernqvist, T. (Sveriges Lantbruksuniversitet, Uppsala. Dept. of Forest Products). 1983. 30p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751409.

The material used in the study was chipped whole-tree spruce from cleaning (precommercial thinnings). Average tree size was about 5 cm (approximately 2 inches) dbh (diameter breast height). The needles relatively dry matter portion was 43.2% and that of the wood 30.6%. The remaining 26.2% was composed of bark, fine twigs and fine fractions. After the fuel were dipped in the different chemical solutions about 2 kg of each solution, as well as the reference material, was placed in it's own plastic sack. A series of plastic sacks with material was stored for 3 months. After the storage period, the moisture content in the reference material from both series was unchanged. In the material wich was dipped in different chemical solutions, the moisture content had sunk in those cases where the dry matter loss was low, but had increased where the dry matter losses had been high. The average value of the dry matter loss between the materials incubated at 22 and 40 degrees was 5.55% for the untreated reference material. Fuel chips wich were dipped in Mitrol 48 show insignificant higher losses than the reference material. Other chemicals, exepting Borax, have the effect that fuel chips cause more than twice as high losses as the reference material. The amount of micro fungi wich grew in the newly chipped material was $3x10^7$ per kg TS (TS=dry matter), while the total amount of fungal particles was $6x10^{10}$. After the storage period the total viable fungal particles in the reference material had increased by about 100 times to $3x10^9$, while the total amount of fungal particles increased by about 5 times to $3x10^{11}$. The two most effective chemicals was Cusol and Mitrol 48. In the fuel chips wich were dipped in these chemicals, no viable fungal particles was observed. Neither could any change in the total fungal particles be observed.(G.B.).

23600 (STEV-EO—84-6) Properties and combustion characteristics of energy forest wood chips, and storage tests of energy wood. Stridsberg, S.; Thoernqvist, T. (Statens Energiverk, Stockholm (Sweden)). Apr 1984. 88p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751437.

This work was concentrated on tests with storage and firing of wood from salix plantations, but has given experiences on other phases in the handling of wood fuels as well. A good drying effect was obtained from pile storage of the trees, six months summer storage resulted in a water content reduction from 47 to 18 percent, a substance loss of 6.5 percent and an energy content increase of 3 percent. Combustion tests were performed in three different boilers. Flue gas values of NOsub(x) and dust were very good; problems frequently arrived with the fuel feeding systems, which however will be overcome by using more rugged equipment. Suggestions are given for a new testing program and for development of new equipment.

23601 (STEV-SB—84-15) Preliminary study of fuel pellets production from dry wood wastes. Schelin, A. (Statens Energiverk, Stockholm (Sweden)). 1984. 33p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751460.

Technical, economic and market relevant possibilities have been investigated, for production of fuel pellets from the wood waste fraction of the industrial waste produced in the Stockholm area. Today, no use is made of this waste. The main focus of the work has been on practical tests, producing pellets from chips made from waste wood, and on combustion test using these pellets. The

results are positive, however a better screening of the raw material would be valuable in order to minimize the ash contents. The market potential for conversion of oil fired plants to pellet firing is very high. A pellets price of SEK 700/ton, which is somewhat higher than the market price, makes such a conversion profitable for the heat producer.

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 23608

23602 **(CONF-7907129—) Small-scale hydro resources development western regional workshop.** (California Univ., Los Angeles (USA)). May 1980. Contract FG01-79RA23206. 242p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE84005144.

From UCLA small-scale hydro resources development western regional workshop; Pomona, CA, USA (30 Jul 1979).

Separate abstracts were prepared for individual papers. (MHR)

23603 (DOE/CE—0105, pp 78-84) **Small-scale hydropower.** Nov 1984. NTIS, PC A05/MF A01. File Number DE85001509.

In Renewable technologies program summaries.

The DOE Small-Scale Hydropower Program conducts research and development to reduce technical and cost uncertainties concerning hydroelectric power installations between 50 kilowatts and 30 megawatts in size.

1303 Plant Design And Operation

23604 **(BFR-R—55-1984) Waste heat from hydropower stations.** Grafstroem, H.; Hedlund, P.; Rydberg, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 47p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751426.

Heat loss from hydropower stations, of which there are 42 with at least 100 MW instal led effect, amount to approx. 0.5 - 2 percent arising from generators or transformers. Of the total installed effect of ca 16 000 MW a considerable amount of energy is wasted. Only 9 stations have a larger consumer of heat energy at 1 km distance. A number of operational and environmental factors limit, however, the chance to utilize waste heat. Where smaller stations, under 100 MW, are concerned only 2 of 10 have potential for waste heat recuperation, but other heating methods for neighbouring buildings were chosen. Some waste utilizing stations and their operational experience are described. Finally, two proposals for recuperation of waste heat in principle for a topical case are discussed for heating a nearby suitable consumer. A pay-off time of approx. 6 years is likely for using waste heat from the transformer only. Another 20 objects are suggested for similar studies as well as alerting owners and country councils to possible savings in the future.

23605 **(TVA/PUB—84/21b) Waterpower '83: conference proceedings. Volume II. Conventional hydro and pumped storage modernization of existing conventional hydro operations.** (Tennessee Valley Authority, Knoxville (USA); Tennessee Univ., Knoxville (USA). Dept. of Conferences and Non-Credit Programs). 1983. 631p. (CONF-830939—Vol.2). NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE84008049.

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Separate abstracts were prepared for individual papers. (MHR)

1304 Regulations And Licensing

23606 **(TVA/PUB—84/21a) Waterpower '83: conference proceedings. Volume I. Small and micro/mini hydro financing, licensing, and legal issues.** (Tennessee Valley Authority, Knoxville (USA); Tennessee Univ., Knoxville (USA). Dept. of Conferences and Non-Credit Programs). 1983. 572p. (CONF-830939—Vol.1). NTIS, PC A24/MF A01; 1; GPO Dep. File Number DE84007682.

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Separate abstracts were prepared for individual papers. (MHR)

1305 Economics And Management

REFER ALSO TO CITATION(S) 23606

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 23901

23607 **(TVA/PUB—84/21c) Waterpower '83: conference proceedings. Volume III. Environmental impacts; research and development; dam safety; general sessions.** (Tennessee Valley Authority, Knoxville (USA); Tennessee Univ., Knoxville (USA). Dept. of Conferences and Non-Credit Programs). 1983. 454p. (CONF-830939—Vol.3). NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE84007687.

From Waterpower '83 - international conference on hydropower; Knoxville, TN, USA (18 Sep 1983).

Separate abstracts were prepared for individual papers. (MHR)

14 SOLAR ENERGY

23608 **(DOE/CE—0105) Renewable technologies program summaries.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of the Deputy Assistant Secretary for Renewable Energy). Nov 1984. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85001509.

The renewable energy research and development program supports development of a mix of technologies that can contribute to both energy supply and improved end-use efficiency. In allocating resources, this office is concentrating on applying federal funds only where they are most effective; in sponsoring research and development (R & D) where the potential payoff is high, but which private industry cannot be expected to pursue because the results are difficult to predict or a return on investment would require an exceptionally long time to be realized. This report summarizes research effort in the following areas: active solar heating and cooling; passive and hybrid solar; photovoltaics; solar thermal; biofuels; wind; ocean energy technology; geothermal; and small-scale hydropower. Separate abstracts have been prepared for each program area for inclusion in the Energy Data Base. (DMC)

23609 **(EFN-LET—1983-06) Planning of future research efforts in the divisional program by the Energy Research Commission covering the follow-up of the technique in the field of solar energy.** (Energiforskningsnaemnden, Stockholm (Sweden)). Feb 1983. 41p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751447.

EFN Planeringsgruppen foer solenergi.

The planning group recommends increased efforts on the area of solar cells. Solar plants could produce 4 TWh per year towards the year 2000. The installation cost will be 40000 MSEK. For the years 1984 to 1987 50 MSEK are required for educational purposes.

1401 Resources And Availability

REFER ALSO TO CITATION(S) 24290

23610 (SERI/PR—215-2526) Summary report: United States participation in International Energy Agency Task IX, Subtask (C) - pyranometry, 1984 participation. Wells, C.V. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1984. Contract AC02-83CH10093. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009615.

After a brief history of the International Energy Agency Solar Heating and Cooling Program and the United States involvement in the pyranometry subtask prior to 1984, involvement in the pyranometry work during 1984 is detailed, including sensitivity tests, temperature response, and a determination of sensitivity of pyranometers during the eclipse of May 30, 1984. (LEW)

23611 (SERI/TR—642-1156) International Energy Agency conference on pyranometer measurements. Riches, M.R.; Stoffel, T.L.; Wells, C.V. (eds.). (Solar Energy Research Inst., Golden, CO (USA); USDOE Office of Energy Research, Washington, DC). Aug 1982. Contract AC02-77CH00178. 408p. (CONF-8103193—). NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE85000082.

From International Energy Agency conference on pyranometer measurements; Boulder, CO, USA (16 Mar 1981).

Separate abstracts were prepared for individual papers. (MHR)

23612 Summary of results from the spectral and angular sky radiation measurement program. Martin, M.; Berdahl, P. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *Solar Energy;* 33: No. 3/4, 241-252(1984).

Extensive measurements of the thermal IR radiance of the sky were obtained at 6 U.S. locations: Tucson, AZ; San Antonio, TX; Gaithersburg, MD; St. Louis, MO; West Palm Beach, FL; and Boulder City, NV. Fifty thousand observations were obtained at half hour intervals during 1979 and 1980. Each observation consists of measurements in 7 spectral bands, wavelengths (in microns) of 8.113.7, 8.3-9.1, 9.4-9.9, 10.0-11.4, 14.0-15.8, 16.6-21.6 and 6-17 at zenith angles of 0, 20, 40, 60 and 80°. The data have been expressed and presented as apparent sky emissivities. It is shown that the measured spectral and angular sky emissivities can be reliably estimated from a knowledge of the total (global) sky emissivity, using an empirical "sky emissivity" equation. The results are of particular relevance to the performance of radiative cooling systems designed to make use of spectral and/or angular selectivity.

23613 Characteristics of infrared sky radiation in the United States. Martin, M.; Berdahl, P. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *Solar Energy;* 33: No. 3/4, 321-336(1984).

A new algorithm has been developed for calculating the thermal radiant temperature of the sky. It is based on a simple empirical and theoretical model of clouds, together with a correlation between clear sky emissivity and the surface dewpoint temperature. Hourly sky temperatures have been calculated based on typical meteorological year (TMY) weather data sets. A summary of the results is presented for calculations made at 193 TMY sites within the continental United States. The results are displayed in the form of monthly contour maps, histograms, and graphs for the purpose of determining regions of the country in which the radiative cooling of buildings appears to be a promising heat rejection strategy.

23614 Estimation of continuous solar spectral distributions from discrete filter measurements. Michalsky, J.J.; Kleckner, E.W. (Pacific Northwest Laboratory, Richland, WA). *Solar Energy;* 33: No. 1, 57-64(1984).

Techniques exist for estimating a well-behaved continuous function given a relatively small number of carefully chosen samples of that function. Two of these methods are applied to the problem of obtaining a low-resolution spectral distribution of direct solar radiation from a few filter samples. The minimum variance estimation and cubic spline fitting techniques are different approaches which yield integrated irradiances within one percent of each other and the test spectrum. They both produce reasonable averaged spectra over most of the spectral interval tested.

1404 Environmental, Legal, And Institutional Aspects

23615 (DOE/R3/02454—T1) Development of the West Virginia Peoples' Energy Network. Fourth and final quarterly report. (West Virginia People's Energy Network, Burlington (USA)). Oct 1981. Contract FG43-80R302454. 56p. NTIS, PC A04. File Number DE85009689.

Three issues of the West Virginia Peoples' Energy Network newsletter are provided, as well as responses to a questionnaire and the financial information for the production of the newsletter. (LEW)

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 23592, 23593, 23595, 23596, 23597, 23598, 23600, 23601, 23650, 23910, 23933, 24296

23616 (DOE/CE—0105, pp 23-31) **Photovoltaics.** Nov 1984. NTIS, PC A05/MF A01. File Number DE85001509.

In Renewable technologies program summaries.

The purpose of the National Photovoltaic Program is to contribute scientific and engineering knowledge of photovoltaic technology which will result in a technology base from which private enterprise can choose options for further development and competitive application. Goals are established for efficiency, cost, and life expectancy that would allow photovoltaic technology, both flat plate and concentrated, to compete with conventional alternatives. The research plan addresses materials research, collector research, and systems research. (LEW)

23617 (DOE/ER/10096—T13) [Gallium arsenide solar cells]. (Howard Univ., Washington, DC (USA)). [1985]. Contract FG05-78ER10096. 17p. NTIS, PC A02; 3; GPO Dep. File Number DE85011085.

A transient liquid phase epitaxial growth system is described, including the growth procedure. Also discussed are the antireflection coating of a gallium arsenide solar cell, the metal contact pattern, and current-voltage characteristics. (LEW)

23618 (DOE/ER/10096—T16) Design and operation of epitaxial reactor. (Rochester Univ., NY (USA)). [1985]. Contract FG05-78ER10096. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85011089.

In the project reported it is intended to improve the efficiency of the Ga/sub 1-x/Al/sub x/As/GaAs solar cell by optimizing the Ga/sub 1-x/Al/sub x/As/GaAs p-n junction. The thrust of the program is to develop a capability to fabricate a solar cell by liquid phase epitaxy. Details of contacts and antireflective coatings are reported. (LEW)

23619 (DOE/ET/20023—T1) Screening Prosopis (mesquite) species for biofuel production on semi-arid lands. Final report, April 1, 1978-March 30, 1981. Felker, P.; Cannell, G.H.; Clark, P.R.; Osborn, J.F.; Nash, P. (California Univ., Riverside (USA). Dept. of Soil and Environmental Sciences). [1985]. Contract FG01-78ET20023. 231p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85010048.

Arid adapted nitrogen fixing trees and shrubs of the genus Prosopis (mesquite) have been examined for woody biomass production on semi-arid lands of southwestern United States. A germplasm collection of 900 accessions from North and South America and Africa was assembled. Field studies screening for biomass production, frost tolerance, response to irrigation, pod production and heat/drought tolerance involved a total of 80 accessions. Selections made from survivors of coal/frost screening trial had more frost tolerance and biomass productivity than prostrate selections from the ranges of Arizona, New Mexico and west Texas. Thirteen Prosopis species were found to nodulate, reduce acetylene to ethylene, and grow on a nitrogen free media in greenhouse experiments. The salinity tolerance of six Prosopis species was examined on a nitrogen free media in greenhouse experiments. No reduction in growth

occurred for any species tested at a salinity of 6000 mg NaCl/L which is considered too saline for normal agricultural crops. Individual trees have grown 5 to 7 cm in basal diameter, and 2.0 to 3.7 meters in height per year and have achieved 50 kg oven dry weight per tree in 2 years with 600 mm water application per year. Vegetative propagation techniques have been developed and clones of these highly productive trees have been made. Small pilots on 1.5 x 1.5 m spacing in the California Imperial Valley had a first and second season dry matter production of 11.7 and 16.9 T/ha for P. chilensis (0009), 7.1 and 6.9 T/ha for P. glandulosa var. torreyana (0001), 9.8 and 19.2 T/ha for P. alba (0039) and 7.9 and 14.5 T/ha for progency of a California ornamental (0163). The projected harvested costs of $25.00 per oven dry ton or $1.50 per million Btu's compare favorable with coal and other alternative fuel sources in South Texas.

23620 **(DOE/JPL/956406—1) Quantitative analysis of defects in silicon: characterization of UCP, HAMCO, and microcrystalline material.** Cohen, R.M.; Stringfellow, G.B.; Natesh, R.; Dunn, J. (Materials Research, Inc., Centerville, UT (USA)). Jan 1985. Contract NAS-7-100-956406. 90p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85006110.

Report MRI-307.

Defect density in HAMCO Czochralski silicon was measured. A sufficiently high precipitate density was found to cause a reduction in the minority carrier lifetime, and thus, cell efficiency. Mobility studies in SEMIX UCP silicon were conducted under both dark and illuminated conditions. Results from these measurements indicate that the grain boundaries act primarily as potential barriers to reduce the mobility. Neutron activation analysis was used on selected samples provided by JPL for testing of trace elemental analysis, yielding generally good results. Thin layers of microcrystalline silicon on single crystal silicon substrates were analyzed to determine hydrogen content, the ratio of amorphous/microcrystalline material, and microcrystal size. Solar cells made with this structure were found to have higher efficiency when containing higher concentrations of hydrogen. 12 references, 48 figures, 8 tables.

23621 **(HNEI—82-02) Biomass resource potential for selected crops in Hawaii.** Seki, A. (Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.). Jun 1982. Contract FG07-80RA50324. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011071.

The biomass crops selected for review were koa haole (giant leucaena), napier and guinea grass, and eucalyptus (saligna, grandis, and globulus). The islands examined were Hawaii, Kauai, Maui, and Molokai. The potential land acreage for growing these crops was estimated grossly. As anticipated, the island of Hawaii had the largest land potential with eucalyptus having the greatest potential land acreage.

23622 (SAND—84-0556, pp 16-26) **Concentrator photovoltaic project overview.** Arvizu, D.E. (Sandia National Laboratories, Albuquerque, NM). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

A review of the concentrator photovoltaic project at Sandia National Laboratories is presented. In the last nine months several significant accomplishments in concentrator photovoltaic technology have been realized. In the baseline silicon cell area cell efficiencies near 21% at 100 suns concentration have been measured. In addition, these cells have efficiencies greater than 20% at over 200 suns. Modeling of silicon devices have improved and it is now projected that silicon cells of advanced designs can achieve greater than 25% efficiency under concentration with some additional technology development. Work is continuing to assess the potential of advanced silicon devices. Advanced thin AlGaAs cells have been fabricated with one-sun efficiencies of greater than 19%. Although problems with material quality and reproducibility are still apparent, this accomplishment paves the way to demonstrate a multiple junction mechanically stacked device with greater than 25% efficiency.

23623 (SAND—84-0556, pp 28-33) **Overview of advanced concentrator cell research.** Gee, J.M. (Sandia National Laboratories, Albuquerque, NM). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

The objective of the advanced device research task is to investigate semiconductor materials other than silicon for high concentration applications. The materials investigated have been the III-V compound semiconductor alloys due to the advanced stage of development of III-V technology. A comprehensive program including device modelling and measurements as well as cell research in both single and multiple junction devices is being pursued by a combination of in-house and contracted work. Work will be supported in FY85 for development of a one-dimensional solar cell simulation program for GaAs solar cells. This work will use, as the foundation, the program developed for Sandia to model silicon solar cells. The multijunction research continues to emphasize a mechanically stacked approach. Significant progress has been achieved in development of a thin AlGaAs cell to stack on top of a silicon cell. A red-enhanced silicon cell for the bottom cell is under development in-house.

23624 (SAND—84-0556, pp 34-43) **19% efficient AlGaAs cells.** Werthen, J.G. (Varian Associates, Inc., Palo Alto, CA). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

This program involves the development of a top cell for a four-terminal, two-cell cascade solar cell. The aim is to demonstrate a high-yield, high-performance, thin, glass-bonded, 1.65-eV AlGaAs solar cell. This is made by first growing suitable epitaxial layers using metal organic chemical vapor deposition (MOCVD) on a GaAs substrate. The cell is then bonded to a glass slide with an adhesive. The substrate is removed, first by lapping and then by an etch which stops at a thin AlGaAs (90% Al) stop-etch layer. Finally, metal contacts are extended to metallized areas on the glass slide. An optimized $Al_{0.3}Ga_{0.7}As$ solar cell has been designed. This n/p cell has a bandgap graded from 1.64 eV at the junction to 1.72 eV at the surface. Before thinning, a number of cells have yielded efficiencies up to 19.2% under 1-sun, AM2 simulated conditions, with an open circuit voltage of 1.18V, a short circuit current density of 14.5 mA/cm^2, and a fill factor of 0.83. One large-area (4 cm^2) cell exhibited 20.1% under simulated 100 mW/cm^2, AM1.5 conditions. One thinned cell bonded to glass has been successfully fabricated and tested. Under simulated 1-sun, AM2 conditions, an efficiency as high as 20% has been observed. Presently, tests have been limited to cells with opaque rear contacts.

23625 (SAND—84-0556, pp 46-52) **GaAsP cells on GaP substrates for use in mechanically stacked converters.** Cape, J.A.; Fraas, L.M.; Partain, L.D.; McLeod, P.S. (Chevron Research Co., Richmond, CA). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

In recent years, efforts have been made to develop monolithic GaAsP/GaAsSb two-color converters. Recently, some non-contract-funded preliminary studies on a novel two-color mechanically stacked cell (MSC) have been carried out. MSC's obviate the need for shorting junctions and 3-terminal configurations, but have generally required fabricating and handling very thin top cells in order to avoid optical losses to the bottom cell. The novel concept reported bypasses this problem by making use of a transparent substrate for the top cell. For these initial studies, substrates of GaP graded to GaAs(0.3) P (0.65) were obtained from Hewlett-Packard and General Instruments. These substrates were intended for LED applications and were therefore non-ideal inasmuch as the doping level was too low for adequate conduction and the composition grading was substantially less than optimum (the residual lattice mismatch to the GaAsP cell was about 1.3%). Nevertheless, by adding two epi-layers of intermediate composition, very promising cell efficiencies, adequate for proof of concept, have been achieved,

and the requirements for significant improvements have been identified and appear to be straight-forward to carry out.

23626 (SAND—84-0556, pp 52) **Materials research for high efficiency cells: overview of SERI-sponsored projects.** Benner, J.P.; Cole, L.A. (Solar Energy Research Institute, Golden, CO). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

Two of the goals of the Department of Energy's Five-Year Research Plan for the National Photovoltaics Program call for increasing the efficiency of large area thin film cells to more than 20% under one sun illumination and increasing the efficiency of multijunction crystalline cells to more than 30% under concentrated sunlight. The High Efficiency Concepts Task supports a program of subcontracted research with the objective of achieving the maximum attainable photovoltaic conversion efficiencies. The emphasis of the program is placed on developing an understanding of the preparation and properties of III-V compound semiconductors. This research is expected to achieve two goals. The first is to improve the quality of ternary and quaternary III-V compounds for use in multibandgap concentrator cells. The second goal is to improve the control of growth of thin film GaAs in order to achieve high efficiency, large area cells. Three distinct approaches are under study including heteroepitaxial growth of single crystal films, free standing single crystal films and improved large grain polycrystalline films.

23627 (SAND—84-0556, pp 54-57) **Si concentrator cell research overview.** King, D.L. (Sandia National Labs., Albuquerque, NM). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

For solar cells that operate in concentrated sunlight, the cell research emphasis should be primarily on cell performance instead of cell cost. Therefore, high conversion efficiency continues to have the highest priority in our Si cell research subtask. Toward this goal activities are directed to three principal areas (1) optimization of baseline planar junction Si (2) development of advanced Si cells (3) cell modelling, evaluation and measurement improvement. Each of these research activities is discussed.

23628 (SAND—84-0556, pp 58-66) **Silicon concentrator cell research.** Spitzer, M.B. (Spire Corp., Bedford, MA). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

The objective of this project is the fabrication of high efficiency Si concentrator cells with a view toward attainment of high open circuit voltage. To this end, a novel structure was designed, modeled, and fabricated which is termed the back junction solar cell. The design combines the best features of a grating, pocket, or point-contact cell with either ordinary fine-line cell metallization systems or novel systems such as Varian's V-groove cell. Since the patterned p/n junction is placed on the back, the junction pattern and metallization grid pattern are independent, allowing for far greater freedom in pattern design that can be achieved with conventional front junction approaches. The design and fabrication of the cell are discussed.

23629 (SAND—84-0556, pp 67-68) **Development of high efficiency silicon solar cells for concentrators.** Ho, F. (Applied Solar Energy Corp., City of Industry, CA). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

Recent improvements in the performance of silicon solar cell for use at one-sun and high concentration have involved improved quality of silicon material, advanced processing technology and evolutionary design of the cell structure. However, the general approach is to reduce losses due to series resistance, gridline shading and front surface recombination. Two approaches believed to be most promising for further improvements have been chosen. These two approaches are (1) grating cell design and (2) passivated, shallow N/P cell, which can give high one-sun efficiency with the chance of providing high efficiency at high concentration levels. Several attempts to fabricate a variety of grating and pocket cells were not promising, and effort was focused on the advanced conventional cell. In the last seven months, work continued on the optimization of front surface passivation on both polished and textured cells.

23630 (SAND—84-0556, pp 69-73) **Si cell optimization experiment.** King, D.L. (Sandia National Laboratories, Albuquerque, NM). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

An experimental investigation of planar junction Si cells was undertaken with the intent of quantifying the influence on performance of several external cell parameters. Results from this experiment will identify optimized concentrator cell designs and will provide measured data that will be used to validate the Purdue 2-D device code and the Basore grid pattern optimization model.

23631 (SAND—84-0556, pp 75-82) **Two-dimensional modelling of concentrator cells.** Schwartz, R.J. (Purdue Univ., West Lafayette, IN). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

There are many factors which limit silicon concentrator cell performance. These include shadowing, series resistance, contact recombination, surface recombination and bulk recombination. All of these limiting factors, except bulk recombination, can be reduced to insignificant levels through proper choice of cell design and careful application of known processing technologies. The performance of an idealized cell was studied in which all of these limiting factors except bulk recombination were eliminated. Under these highly idealized conditions, it is possible to develop a set of efficiency contour curves for various levels of base doping and base widths. Theoretical maximum conversion efficiencies (AM1.5) of 23.4% at 1 sun, 32% at 100 suns and 36% at 1000 suns are predicted. It is interesting to note that the maximum conversion efficiencies were found for very thin cells (less than 75 microns) with lightly doped bases (less than 1×10^{15} cm^3) and reflecting back surfaces. This is in contrast to the best presently available cells which are relatively thick and heavily doped.

23632 (SAND—84-0556, pp 83-90) **Grid-line optimization analysis and 1-D computer code on PC.** Basore, P.A.; Rover, D.T. (Iowa State Univ., Ames). Jul 1984. NTIS, PC A13/MF A01. File Number DE85001444. (CONF-8408116—).

From 12. photovoltaic concentrator project integration meeting; Albuquerque, NM, USA (28 Aug 1984).

The quasi-one-dimensional model of solar cell grid topologies has been successfully applied to the determination of optimum grid designs. The critical assumption in the optimization procedure is that all grid lines have the same thickness which is limited in direct proportion to the minimum linewidth used. If, in addition, the illumination profile varies only along the longitudinal direction (the direction of current flow in the grid), then the procedure yields optimum values for grid-line width and spacing. The optimum width is uniform across the cell, but the optimum spacing is continuously-varying in the longitudinal direction. A computer program to simulate solar cell operation is being developed for use on personal computers as an interactive, graphical tool for cell research and development. The computer model has several salient features. The numerical simulation is based on a finite difference method in which the equations are derived assuming that the carrier densities vary exponentially between nodes. The electric field, which is self-consistent with the carrier densities, is updated as each node is processed. Also, the presence of surface charge at ohmic contacts is included to more accurately simulate the time progression of the system. The model will eventually incorporate both fixed-voltage and fixed-current boundary conditions, light-generated current, and heavy-doping effects.

23633 (SAND—84-0627C) Liquid metal thermoelectric converter (LMTEC) for solar applications. Martinez, J.I. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-850252—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008405.

From Solar thermal research program annual conference; Denver, CO, USA (20 Feb 1985).

An overview is given of the research and development plan for the Liquid Metal Thermoelectric Converter (LMTEC) being undertaken by Sandia Laboratories under the Solar Thermal Technologies program of DOE. Sandia initiated work in this area less than a year ago and has pursued the work as a specific subtask starting in FY 1985. As with any new project, a significant part of the initial effort has been spent on reviewing the current technology in thermo-electric converters including Thermally Regenerative Electrochemical Systems (TRES), fuel cells, thermionic devices, magnetohydrodynamics, and other modes of direct thermal-to-electric conversion. Consequently, no formal research results are included in this paper and the presentation is intended more to indicate those areas in which further research and development efforts could be expended to prove of positive impact on the solar application of LMTEC. The principal objective of this task is to design, engineer, and develop a LMTEC suitable for use in solar distributed receiver applications. Since the thermal requirements for the LMTEC are in the temperature range of parabolic dishes, the engineering development effort will concentrate on a device that can be mounted at the focal point of a dish and preferably incorporated into the receiver. Due to a technology review, the LMTEC most likely will be based on the current Sodium Heat Engine (SHE) concept. Our main effort will consist of optimizing the concept for solar applications and conducting the necessary engineering development to produce a 20 to 50 kWe device.

23634 (SAND—84-1694) Assessment of the impact of missing values in the southwest residential experiment photovoltaic array data records. Hall, I.J.; Menicucci, D.F.; Frost, E.L. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1985. Contract AC04-76DP00789. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008699.

Data films used by Sandia National Laboratories, Albuquerque (SNLA) to develop computer simulation programs for photovoltaic (PV) systems have data gaps as a result of malfunctions of the data acquisition system or human error. The gaps introduced error into the summary statistics computed from the incomplete files and disrupt the standard methods used to input data to the simulation programs. To improve the quality of the PV data files, SNLA conducted a study to determine (1) the frequency and length of the data gaps and (2) the effect of filling the data gaps with values determined by linear interpolation. The study results indicate that the amount of data missing from the files is not serious and that linear interpolation is an adequate solution. These results provide a method for estimating values to fill in the gaps in incomplete files, allow the analyst to compute summary statistics from these files, allow easy input of data to computer simulation programs, and, in general, increase the quality and usefulness of the data base.

23635 (SAND—84-2002C) Optical effects of thin film adhesives in multijunction solar cells. Siegel, R.B. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 8p. (CONF-850408—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010120.

From 6. European photovoltaic solar energy conference and exhibition; London, UK (15 Apr 1985).

Multijunction solar cells afford an attractive method of increasing module efficiency. The optical coupling of mechanically stacked cells causes some concern since the gains from the bottom cell can be effectively negated by reflectance losses between the cells. A short outline of the theory of thin film optics as applied to this situation is presented. Theoretical reflectances of single and multiple layer thin films between AlGaAs and Si cells are developed. An option currently being investigated for a series connected multijunction cell is illustrated. The multijunction cell with a multilayer optical coupling could have less than 1% reflectance loss between the cells. This compares most favorably to the ~25% reflectance loss of thick adhesive layers, and approaches the reflectance of monolithic systems.

23636 (SAND—84-7025) High-efficiency, low-cost, passively-cooled PV concentrator module. Kaminar, N. (Varian Associates, Palo Alto, CA (USA). Solid State Lab.). Feb 1985. Contract AC04-76DP00789. 215p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85010013.

The objective of this program was to develop a high-concentration, high-efficiency GaAs module using passive cooling. The module consists of a panel of thirty-six 7-inch square Fresnel lenses attached to an anodized aluminum heat dissipator sheet with a wire frame. Thirty-six 1/4-inch sealed GaAs cell packages are mounted to the aluminum with individual studs. A solid glass secondary is cemented to the cell to improve the on- and off-track performance. The overall geometric concentration ratio is 1000:1. Module efficiency was about 17% with +- 0.8° tracking error. The secondaries improved the flux distribution of the off-track performance. Cell junction temperature was less than 60° with the passive cooling.

23637 (SAND—85-0946C) Mechanically-stacked multijunction solar cells. Gee, J.M. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 15p. (CONF-850408—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010389.

From 6. European photovoltaic solar energy conference and exhibition; London, UK (15 Apr 1985).

The results of experiments to simulate the performance of mechanically-stacked, multijunction solar cells are reported. The simulation consisted of stacking an AlGaAs optical filter on top of a silicon cell and measuring the silicon cell's output. Analysis of the experimental results was able to quantify the various mechanisms (absorption and reflection) that resulted in the loss of silicon cell output. Calculations were also performed to compare the relative merits of two different types of silicon cells and an InGaAs cell for stacked cell applications.

23638 (SAND—85-0951C) Photovoltaic concentrator research status. Arvizu, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-850408—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010119.

From 6. European photovoltaic solar energy conference and exhibition; London, UK (15 Apr 1985).

This paper describes the most important developments in concentrator research and development since the fifth E.C. Photovoltaic Energy Conference in October 1983. Within the Sandia managed Photovoltaic Concentrator Research Project several record cell efficiencies have been reported. Applied Solar Energy Corporation has fabricated a concentrator silicon cell with 20.9% peak efficiency, at 90X concentration. Varian Associates has demonstrated a 26.0% efficient GaAs cell at 700X concentration. Hughes Research Labs together with Applied Solar Energy Corporation and Sandia has demonstrated a 24.7% efficient, at 70X concentration, mechanically-stacked multijunction device using GaAs on silicon. In addition, a record efficiency for silicon technology has been demonstrated with the Sandia developed 200X silicon module. The module has been measured to have 17% peak efficiency. This paper will review these accomplishments, other research progress, and current research directions in concentrator cells, modules, and arrays. A brief economic assessment is also presented which indicates the potential of concentrator technology.

23639 (SERI/PR—211-2468) Post-deposition heat treatments of CdS/$CuInSe_2$ solar cells. Zweibel, K. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1985. Contract AC02-83CH10093. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002943.

CdS/$CuInSe_2$ thin-film solar cells are being fabricated at or above 10% efficiency at Boeing, IEC, SERI, and ARCO. In each case, there is a similar air or oxygen heat treatment performed after the cell deposition is completed, raising efficiency significantly. Performance alterations vary, but post-annealed cells are often improved by over 100% in efficiency. Although no optimized CdS/$CuInSe_2$ cell is made without an anneal, the anneal has been poorly

understood in terms of the actual physical-chemical changes it produces. This review describes the anneal and summarizes our understanding of it. Greater knowledge of the anneal's character should help us to understand and to improve the CdS/$CuInSe_2$ cell.

23640 (STEV-EO—84-1) Commercial cultivation of energy forests in the agricultural sector. Hearne, L. (Statens Energiverk, Stockholm (Sweden)). 1984. 176p. (In Swedish). NTIS (US Sales Only), PC A09/MF A01. File Number DE85751410.

This report investigates a specific business concept based on small scale cultivation of energy forest by farmers. The energy forest areas would spread throughout Sweden and heat producers would have access to a local energy source. (We ask) whether or not it is profitable to establish an energy forest company as a link between the cultivator and the heat producer. The responsibility of an energy forest company would be to: Coordinate loans to the cultivators and establish the conditions for cultivating through individual contracts. Transfer know-how to new cultivators. Buy the cultivators production. Process energy forest. Transport the energy product to the user. Establish supply contracts with users of energy forest. Develop techniques for using solid fuels and for processing wood products for energy. Inform authorities on local, regional and central levels on developments within the energy field. Spread information from authorities to cultivators and users of energy forest. The average annual costs of production are 345-640 SEK/toe at the present state-of-the-art and 285-495 SEK/toe at the technical level developed in 3-5 years. The probable market price for the product is between 440-605 SEK/toe. The Swedish heating plants association estimates that 12 percent of Swedens district heating will be produced from wood chips in year 2000, and that more than half of all district heating companies, will use wood chips for heat production. In total this means 47 boilers, which can provide 65000 one-family residences with heat. This forecast for the use of chips for energy in year 2000 is low. The Swedish Heating Plants Association makes the assumption that coal will produce 60 percent of Swedens district heating in year 2000. Due to the long-term perspective and the risks involved - economic as well as political - it seems unavoidable that the public sector must become involved if small scall energy forest cultivation is to get off the ground.

23641 Improved performance of surface-passivated solar cells by chlorine-containing oxides. Jackson, M.A.; Rao, B.B.; Anderson, W.A. (Department of Electrical and Computer Engineering, State University of New York at Buffalo, Bonner Hall, Amherst, New York 14260). *Journal of Applied Physics;* **57**: No. 10, 4742-4745(15 May 1985).

Many metal-oxide-semiconductor (MOS) devices rely upon surface passivation for improved performance. An oxide grown in the presence of Cl was evaluated using highly efficient, surface-passivated, photovoltaic cells. The Cl-containing oxide gave increased efficiency, increased stability, and reduced surface-state density. Spectral response, Auger, and secondary ion mass spectrometry (SIMS) data support these conclusions. Preliminary results regarding stoichiometry of the oxide are presented.

23642 Studies of a photosynthetic photoelectrochemical cell using various electrodes. Sanderson, D.G.; Pan, R.L.; Gross, E.L. (Ohio State Univ., Columbus). *Applied Biochemistry and Biotechnology;* **8**: 395-405(1983). Contract FG02-79ER10538.

The authors have developed a photochemical cell using a combination of photosynthetic electron transport (photosystem I particles) and the photoreduction of a dye such as flavin mononucleotide (FMN). The overall power conversion efficiency depends on the rates of charge transfer across the electrode surfaces in addition to the efficiency of the photosynthetic and photochemical reactions. For this reason, they studied the effect of varying the nature of the electrodes on the power developed. It was found that reticulated vitreous carbon electrodes showed higher power conversion efficiencies than did nickel mesh, platinum, or SnO_2 glass. Substituting RVC electrodes for platinum increased the power conversion efficiency from 1.0 to 3.9%. Platinizing platinum, nickel mesh, or brass electrodes also increased the power developed. However, the photopotential remained stable for several hours only for the platinized platinum electrodes.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 23616

23643 (DOE/R3/02402—T1) Use of photovoltaic cells as part of a solar domestic hot water system. Kagel, A.D. (Kagel (Allen D.), Newark, DE (USA)). [1983]. Contract FG43-80R302402. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009176.

A photovoltaic power source was used to drive a dc pump in a 2 panel, 66 gal solar domestic hot water solar system. This project demonstrated the potential for solar electrical generation in a potentially broad practical application. The pv was mounted between the flat plate collectors so that when the sun heated the flat plates, the sun would activate the pv and run the pump. A mechanical time lapse indicator was added to measure circulation time and a flow meter measured the rate of flow in the closed loop of the solar system.

23644 (HNEI—84-02) Hawaiian photovoltaic residential systems and evaluation. Final report. Takahashi, P.; Seki, A.; Curtis, G. (Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.). Jun 1984. Contract AC04-76DP00789. 58p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009761.

This report on the Hawaiian photovoltaic (PV) residential systems covers the period from July 1982 to October 1983 of an ongoing project. The three PV units located on two different islands (Oahu and Molokai) were kept operational, maintained, and data evaluated and analyzed. Modifications on two units were made by installing more efficient inverters, which improved energy quality. The wiring of the Pearl City unit was redone to include the other units in the apartment complex. This provided less energy to the original tenant but made better use of the exported energy. The systems for the most part were trouble-free and on-line for about 96% of the time.

23645 (SAND—83-7019) Dynamic simulation of dispersed, grid-connected photovoltaic power systems: system studies. Wasynczuk, O.; Carroll, D.P.; Gareis, G.E.; Krause, P.C.; Ong, C.M.; Schwartz, R.J. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). Mar 1985. Contract AC04-76DP00789. 272p. NTIS, PC A12/MF A01; GPO Dep. File Number DE85011179.

To investigate the operating characteristics and dynamic behavior of photovoltaic (PV) power systems, four PV system configurations were selected as representative of those currently being used in PV applications. These included single and three phase, line and self commutated power conditioners with a flat-plate PV array as the dc source. Detailed computer models of each of these systems were developed and incorporated into dynamic representations of typical primary and secondary distribution feeders. The dynamic electrical behavior of the PV and distribution systems following common network disturbances such as large load changes, PV system startup, and cloud cover transients are characterized. The dynamic behavior was also investigated during abnormal operating conditions following line faults, PV system malfunctions, and islanding of distribution systems containing significant levels of dispersed PV generation. Results of verification tests involving two of the single phase PV system configurations, in which the simulated response characteristics are compared with actual measurements, are also provided.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 23692, 23693, 23694

23646 (DOE/CE—0105, pp 32-38) **Solar thermal.** Nov 1984. NTIS, PC A05/MF A01. File Number DE85001509.

In Renewable technologies program summaries.

Solar thermal systems are briefly described. A progress update and federal/industry cooperation of the program are reported. The purpose of the Solar Thermal Technology Program is to foster the development of solar thermal systems that will have the

potential for displacing the use of non-renewable energy resources. Included in the research plan are central receivers, distributed receivers, materials and components, and concentrators. Program management, organization, review and assessments, and technology transfer are outlined. A budget summary of the program is provided. (BCS)

23647 **(DOE/DR/00789—T109) Model for the economic assessment of solar power plants.** Faninger, G.; Bucher, W.; Geyer, M.; Klaiss, H.; Thornton, J.P. (Austrian Solar and Space Agency, Vienna; Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (Germany, F.R.); Solar Energy Research Inst., Golden, CO (USA)). Sep 1984. Contract AC04-76DR00789. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85009355.

Economic evaluations of central receiver system plants of 10, 30, and 100 MW and of a distributed collector system plant of 10 MW were performed based on projected data sets. A study on the appropriateness of different calculation methods is included. As cost calculation methods primarily the annuity method and the life cycle costs methods were taken as a basis.

23648 **(SAND—83-8019) 10 MWe Solar Thermal Central Receiver Pilot Plant total capital cost.** Norris, H.F. Jr. (Sandia National Labs., Livermore, CA (USA)). Feb 1985. Contract AC04-76DR00789. 188p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85009113.

A detailed breakdown of the capital cost of the 10 MWe Solar Thermal Central Receiver Pilot Plant located near Barstow, California is presented. The total capital requirements of the pilot plant are given in four cost breakdown structures: (1) project costs (research and development, design, factory, construction, and start-up); (2) plant system costs (land, structures and improvements, collector system, receiver system, thermal transport system, thermal storage system, turbine-generator plant system, electrical plant system, miscellaneous plant equipment, and plant level); (3) elements of work costs (sitework/earthwork, concrete work, metal work, architectural work, process equipment, piping and electrical work); and (4) recurring and non-recurring costs. For all four structures, the total capital cost is the same ($141,200,000); however, the allocation of costs within each structure is different. These cost breakdown structures have been correlated to show the interaction and the assignment of costs for specific areas.

23649 **(SAND—84-8186) Thermal storage test report: TSU bed conditioning (1040A), Thermal Storage System controls test (1040B).** (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)). Nov 1984. Contract AC04-76DR00789. 260p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85010033.

The objective of the thermal storage unit (TSU) bed conditioning test program was to heat the thermal storage media (rock, sand, and oil) in the TSU to 250°F to 300°F removing all water in the bed and enabling oil circulation at higher flows and temperatures for removal of contamination and sediment from the oil. The acceptance criteria were considered satisfied when the bed was heated to a minimum of 250°F, and the filters in the oil charging loops had a pressure drop of less than 2 psid during two hours of oil flow at an oil flow rate of 500,000 lb/hr in each train at an oil temperature of 250°F. The general objectives of the thermal storage system controls test were to: verify the process operation of solar specific portions of the plant, develop the control functions and/or field tune the individual plant controllers, and verify selected portions of the Plant Operating Procedures. The first portion involved bringing the flash tank loops into service as well as the main inlet steam and desuperheater loops. The second part involved charging loop subsystem. The third portion involved the extraction loop subsystem. The activities of this test deal with functional tests of control loops and limited control loop tuning and with tuning of control loops and performing closed loop testing over full operating ranges of temperature, pressure, and flow. (LEW)

23650 **(SERI/TP—251-2671) Solar Thermal Research Program.** Gupta, B.P.; Carasso, M.; Nix, R.G. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1985. Contract AC02-83CH10093. 12p. (CONF-850301—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000514.

From 12. annual energy technology conference and exposition; Washington, DC, USA (25 Mar 1985).

The principal objective of the Solar Thermal Research Program is to conduct research leading to assessments of the feasibility of new concepts that can be cost-competitive over the entire temperature range. Research opportunities are identified by determining cost and performance targets and by conducting exploratory research on innovative concepts that use concentrated solar flux. The program has conducted basic and applied research in materials, thermal sciences, chemical sciences, and engineering analysis needed to provide the knowledge base for new technology. Collector technology research includes optical materials, concentrators, and receivers. Research is also aimed at efficient conversion of concentrated solar flux into electricity and direct photo/thermochemical conversion. Activity is directed at the generation and characterization of innovative concepts and applications. (LEW)

23651 **(SERI/TP—255-2001) High temperature molten salts for use in solar thermal energy systems.** Coyle, R.T.; Copeland, R.J.; Burrows, R.W.; Goggin, R.M. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1983. Contract AC02-77CH00178. 30p. (CONF-830511—3). NTIS, PC A03/MF A01; GPO Dep. File Number DE85009873.

From 6. international symposium on salt; Toronto, Canada (24 May 1983).

Advanced molten salts (hydroxides, carbonates, and chlorides) are being researched for solar thermal applications. These salts may be used in the receiver working fluid and in thermal energy storage. Potential applications include electric power production, fuel and chemical production, and high-temperature process heat. Molten salts can store sensible heat at temperatures up to 1100°C in a thermocline system. Salt corrosion of the insulating and containment materials is a major area of concern and current results on corrosion in hydroxide and carbonates are described.

23652 **Solar-fossil hybrid system analysis: performance and economics.** Griffith, L.V.; Brandt, H. (Lawrence Livermore National Laboratory, Livermore, CA). *Solar Energy;* 33: No. 3/4, 265-276(1984).

This study has developed a method of accounting for the dominant energy flows within a solar fossil hybrid power plant. The method is incorporated in a computer code called HYBRID, which can be linked to a solar central receiver code such as STEAEC. STEAEC, or a similar code, must be used to calculate the power from the solar central receiver (solar power) on an hourly or quarter-hourly basis. HYBRID determines the quantity of solar power directed to thermal storage, the quantity of solar power directed to a specified load, the amount of power retrieved from thermal storage, and the mass of fuel used by the fossil portion of the hybrid power plant. HYBRID uses the calculated fuel requirements to determine the present value of required revenue for the life of the plant. Fuel consumption is shown to be a dominant variable cost in the economic evaluation of a solar-fossil hybrid system. Fuel costs and other economic parameters are normalized to the present value of the capital investment. The range of normalized parameters is established to reflect economic unknowns and system design variability. It is shown that, under the most favorable economic conditions allowed in this study, the present value of the capital investment for a solar-fossil hybrid system should not exceed 2.5 times the present value of the capital investment for a comparable fossil power system if the hybrid is to be economically competitive. Under more probable conditions, this ratio declines to 1.5 - 2.0.

1408 Ocean Energy Systems

23653 **(ANL/EES-TM—271) Numerical techniques for steady two-dimensional transcritical stratified flow problems, with an application to the intermediate field dynamics of Ocean Thermal Energy Conversion plants.** Jones, J.M.; Jirka, G.H.; Caughey, D.A. (Cornell Univ., Ithaca, NY (USA). School of Civil and Environmental Engineering). Jan 1985. Contract AC02-78ET20483;W-31-109-ENG-38. 360p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85008347.

The development of predictive techniques for the predominantly horizontal, layered fluid motions that result when a continuous buoyant source is discharged into an ambient fluid at a bounding surface, interface or equilibrium level is studied. Although the numerical techniques developed are applicable to general discharge configurations, the model development is focused on the particular case of a radial source of buoyancy and momentum discharged into a uniform ambient crossflow. The resulting density current is analyzed by application of the depth-integrated hydrodynamic equations. The density current dynamics are shown to vary with the relative intermediate- to near-field strengths, as characterized by the ratio of their respective length scales. The complete range of this interaction, from small near-field effects to large near-field effects, is investigated. Results are presented as the depth integrated velocity and current thickness distributions for different field strength values. The model predictions are compared to two sets of laboratory data and to limited field information, involving a river discharge and a submerged outfall into the ocean. Good agreement is obtained in all cases. Finally, the model results are applied to the prediction of a river plume into a coastal ocean current and to the continuous discharge from an OTEC plant operating in the stratified ocean. In both cases, the results indicate the significant horizontal extent (order of several kilometers) of the resulting current, together with their limited vertical extent (order of several meters). Their strong sensitivity to ambient current magnitude and stratification strength is demonstrated.

23654 **(CONF-8303103—1) Ocean energy systems.** Richards, D.; Dugger, G.L.; Weiskopf, F.B. Jr. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1983. Contract AI01-77ET20342. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008378.

From International symposium on renewable energy sources; Lahore, Pakistan (18 Mar 1983).

This lecture deals primarily with the two ocean energy subjects with which the speaker and his colleagues at The Johns Hopkins University, Applied Physics Laboratory are most familiar: (1) Ocean Thermal Energy Conversion (OTEC) plants, which use the temperature difference (ΔT) between warm and cold water to drive a heat engine and thence generate electricity, and (2) a Pneumatic Wave Energy Conversion System (PWECS) in which a wave-driven oscillating air column in a chamber drives a turbine-generator. A brief summary is also presented on the Dam-Atoll wave energy concept. For Pakistan, interest in OTEC might be directed mainly toward use of OTEC power onboard cruising plantships to make ammonia (for fertilizers), methanol (for vehicle fuel and for electric power regeneration ashore) and other energy-intensive products.

23655 (DOE/CE—0105, pp 55-67) **Ocean.** Nov 1984. NTIS, PC A05/MF A01. File Number DE85001509.

In Renewable technologies program summaries.

A brief description of the Ocean Energy Technology Program is presented. Progress and federal/industry cooperation of the program are discussed. The purpose of the Department of Energy's OET Program is to develop a technological data base and reduce high risk technical uncertainties associated with ocean derived energy sources. Plans for research include thermodynamic analysis (open-cycle, closed-cycle, and alternative energy systems), pneumatic wave energy conversion, oceanographic environmental and geotechnical, materials and structures, experimental verification and testing, and engineering development. Program management, organization, review and assessments, and technology transfer are outlined. A budget summary for each research area is included. (BCS)

23656 (DOE/NBM—5007889) **Ocean thermal energy conversion.** Avery, W.H. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 17 Mar 1983. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007889.

A brief explanation of the Ocean Thermal Energy Conversion (OTEC) concept and an estimate of the amount of energy that can be produced from the ocean resource without introducing environmental concerns are presented. Use of the OTEC system to generate electric power and products which can replace fossil fuels is shown. The OTEC program status and its prospects for the future are discussed.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 23643, 23650, 23683, 23684, 23687, 23688

23657 (DOE/CE—0105, pp 2-10) **Active solar heating and cooling.** Nov 1984. NTIS, PC A05/MF A01. File Number DE85001509.

In Renewable technologies program summaries.

A technical description, progress update, and federal/industry cooperation of the Active Solar Heating and Cooling Program are briefly discussed. The program goal is to bring efficient, economically competitive, and environmentally acceptable solar technology options into the marketplace by developing the technology base for subsequent private sector initiatives. The research plan covers two major areas: materials and components (collectors, absorption chillers, Rankine chillers, and desiccant cooling); and systems (simulation and analysis, experimental, and performance monitoring). Program management, organization, review and assessments, and technology transfer are outlined. A budget report for the program is included. (BCS)

23658 (DOE/CE—0105, pp 11-22) **Passive and hybrid solar.** Nov 1984. NTIS, PC A05/MF A01. File Number DE85001509.

In Renewable technologies program summaries.

Passive and hybrid solar technologies are briefly discussed. A progress update and federal/industry cooperation of the program are reported. The program goal is to provide industry with the capability to significantly reduce conventional building energy consumption and to increase the contributions of solar energy and use of natural elements in meeting energy demands. Included in the research plan are aperture materials and components, thermal storage, thermal transport subsystems, systems simulation and analysis, experimental systems, daylighting and resource characterization, heat transfer, passive cooling, performance monitoring and evaluation, and design tools. Program management, organization, review of assessments, and technology tranafer are outlined. A budget report of the program is provided. (BCS)

23659 **(DOE/R3/02406—T1) Demonstration of a passive solar heating system.** Pariseau, C.E.; Pariseau, D.L. (Pariseau (Charles E.), Swanton, MD (USA); Pariseau (Deborah L.), Swanton, MD (USA)). 1 Jun 1981. Contract FG43-80R302406. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009178.

A passive solar heating system is demonstrated in which the windows covering 80% of the south wall of a house are covered with insulating shades, and heat was distributed from an overheated loft to the rest of the house via down-draft ducts, driven by small electric fans. (LEW)

23660 **(DOE/R3/02427—T1) Woodworking Center. Final report.** Brinton, J. (Brinton (Jasper), Phoenixville, PA (USA)). [1982]. Contract FG43-80R302427. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009269.

A wood drying solar kiln was constructed with a usable interior space of 20 ft x 6 ft x 4 ft that can accomodate 2000 board feet of stickered lumber. A workshop studio, 40 ft x 40 ft and two floors high, was also constructed, banked into hillside as a passive solar structure using the envelope concept of air convection. Cooling is effected by a ventilating tower. (LEW)

23661 **(DOE/R3/02434—T1) [Solar water heating system and hand-made collector]. Final technical report.** Jones, E.H. (Jones (Edward H.), Richmond, VA (USA)). 2 Dec 1981. Contract FG43-80R302434. 17p. NTIS, PC A02. File Number DE85009265.

A hot water heating system was constructed using four collector panels hand made with tin cans as reflectors. Costs of materials and construction time are listed for one panel, drawings and photographs of the system are presented, and a list of invoices is included. (LEW)

23662 **(DOE/R3/02450—T1) Project Gemini: a solar energy greenhouse.** Cross, K.J. (Clay-Battelle High School, Blacksville, WV (USA)). 28 Sep 1982. Contract FG43-80R302450. 58p. NTIS MF A01; 2; GPO Dep. File Number DE85009412.

Reported are the siting and the construction of a solar energy greenhouse performed by students at Clay-Battelle High School in Blacksville, WV. Lack of funds prevented the construction of passive solar collectors, but plans for a heat storage unit are included. (BCS)

23663 **(DOE/R3/02451—T1) [Solar dryer. Final report].** Scanlin, D. (Scanlin (Dennis), Morgantown, WV (USA)). [1985]. Contract FG43-80R302451. 12p. NTIS, PC A02. File Number DE85009411.

A small solar lumber dryer was designed and constructed with the involvement of junior high students. The dryer is a natural convection solar collector similar in shape to an attached solar greenhouse. The design of the kiln is described, modifications are proposed, and the performance is briefly discussed. (LEW)

23664 **(DOE/R3/02455—T1) Supplemental solar heating with concentrating collectors and large storage. Final report.** Parsons, D. (Parsons (Dale), Charleston, WV (USA)). 14 Dec 1981. Contract FG43-80R302455. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009330.

The objective is to develop a reliable, low cost, efficient solar heating system to help overcome rising utility costs, one that does not dictate or limit architectural treatment and practical for West Virginia climate. Features include back yard mounted concentrating solar tracking collectors and a large water storage capacity. This choice of concentrating collector minimizes collector area and attendent costs, increases effective storage capacity and frees the structure of a distracting array of panels. Each square foot of the concentrating collector is equivalent to about 3.5 square feet of panel average daily. Thus the purchase price of panels alone approaches the cost of this proposal. A large heat reservoir is essential for extended sunless periods of several days or even weeks. Water has the highest heat storage per unit volume of any material (neglecting phase change); it is cheap, requires far less volume than a comparable rock storage and is easy to control. For these reasons a 12,000 gallon tank with thermal storage capacity approaching 25% of the annual heating requirement was selected.

23665 **(DOE/R3/06050—T1) [Passive solar retrofit of elderly group home]. Final report.** (Sussex County Community Action, Georgetown, DE (USA)). [1985]. Contract FG43-79R306050. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009218.

The initial activity was to have an energy analysis performed on an elderly group home. The analysis was completed and several recommendations are given, such as increasing insulation in the sidewalls to R-19, considering a water-source heat pump, and constructing a sunspace rather than a greenhouse to offset summer heat build-up while maintaining benefits of a sunspace buffer. Residents are to be trained in the operation of movable insulation, and thermostats are to be locked. (LEW)

23666 **(DOE/R3/06051—T1) Solar/OPTION I. Final report.** Quade, J.R. (New Castle County School District, Newark, DE (USA)). 26 Aug 1981. Contract FG43-79R306051. 19p. NTIS, PC A02. File Number DE85009203.

This project was designed in order to provide a working demonstration of active and passive solar heating systems in a vocational/career program center. The active liquid system was installed by a contractor and the solar greenhouse was built by students. (BCS)

23667 **(DOE/R3/06061—T1) [Microprocessor-based controller for residential solar heating system].** (Kilian (Christopher), Stevensville, MD (USA)). 1982. Contract FG43-79R306061. 110p. NTIS, PC A06. File Number DE85009246.

The purpose of this project was to develop a microprocessor based controller for an existing solar heating system, and to demonstrate that such a controller could increase the net solar energy output. In the first stage of the project an analysis was made to determine those areas where a "smart controller" could improve efficiency. Software strategies were developed to implement these improvements and a program was written. A detailed description of results of this effort is given. The hardware was designed around the Intel 8080 microprocessor and a working model was built. While the hardware design is unique to this application, it is not innovative in the sense that new ground was broken. The hardware design is discussed. After the software and hardware were debugged, the unit was connected to an existing solar heating system for evaluation testing. The unit performed as designed, making the correct energy management decisions. Analysis of test data showed the "smart controller" was able to improve system efficiency but the amount of improvement varied widely depending on climatological and other conditions. In general, the contribution of the new controller was more significant as the solar conditions declined. These findings are presented.

23668 **(DOE/R3/06064—T1) Albright residence. Final report.** Albright, P.H. (Albright (Paul H.), Aberdeen, MD (USA)). Sep 1980. Contract FG43-79R306064. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009215.

The activities covered by this program included the installation of approximately 500 square feet of field-built air collectors, and interfacing them with a conventional heat pump to maximize the efficiencies inherent in the heat pump system. Included in this system is a 450 cubic foot rock storage bin centrally located in the basement of the residence for carry over storage.

23669 **(DOE/R3/06065—T1) [Solar greenhouse and barn collector].** Woodward, M.V. (Woodward (Mary Victoria), Port Deposit, MD (USA)). 4 Aug 1981. Contract FG43-79R306065. 2p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009216.

Use of a solar greenhouse and solar collectors to provide heat on a farm is briefly discussed. The greenhouse was used to heat the home, and the solar collectors provided hot water and heat for the barn. About $1500 was saved in oil bills from the previous year. (BCS)

23670 **(DOE/R3/06067—T1) [Passive solar heat]. Final report.** Gula, P.P. (Gula (Patricia P.), Mount Airy, MD (USA)). 7 Aug 1981. Contract FG43-79R306067. 102p. NTIS, PC A06. File Number DE85010165.

The overall purpose of the demonstration reported was to encourage consumers to use passive solar heat. There were four primary objectives: to document the effectiveness of a simple passive solar design; to demonstrate the feasibility of individual planning and application of passive solar heating concepts; to produce a consumer oriented publication encouraging the use of passive solar heat; and to demonstrate the use of energy efficient woodstoves as the primary auxiliary heat source in a passive solar house. Highlights of the performance of the passive solar house during its first winter of operation are given, as well as a description of the planning approach as a demonstration of the consumer being directly involved in decisions underlying passive solar building or remodeling. Some of the more technical details on performance and analytical methods are provided. (LEW)

23671 **(DOE/R3/06114—T1) Solar heated firewood dryer for the homeowner. Final report.** Wengert, E.M. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). [1985]. Contract FG43-79R306114. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009243.

This demonstration project involved demonstrating the construction and operation of 10 solar heated firewood dryers for the homeowner and dissemination of the plans for these dryers. Over 10,000 copies of the plans were distributed.

23672 **(DOE/R3/08068—T1) Combination wind turbine generator and solar hot water system.** Mills, J.L. Jr. (Mills (Joseph L., Jr.), Jarrettsville, MD (USA)). 31 Mar 1983. Contract FG43-81R308068. 51p. NTIS, PC A04. File Number DE85009205.

This demonstration combined two renewable sources of energy, wind and solar, to meet the needs for a hot water system and electrical generation. A new and unique wind blade design called a Helical Wind Turbine was used. The solar hot water system used was commercially produced. The project has demonstrated that wind generators are feasible in Harford County, Maryland.

23673 **(DOE/R3/08073—T1) Development of a commercial aquaculture system utilizing solar energy and recycled waste. Final report.** Westbrook, D. (Westbrook (Donald), Baltimore, MD (USA)). 27 Sep 1982. Contract FG43-81R308073. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009160.

Successfully designed and constructed was a hot air solar heated structure to house a pool for the freshwater shrimp which were expected to grow on feed composed of chicken waste products. The main pool and a series of smaller test pools were installed and were conducted on manures, algal growth, and water conditions.

23674 **(DOE/R3/08079—T1) [Retrofitting a house with a greenhouse and thermal storage wall].** Goenner, M.D. (Goenner (Michael D.), Takoma Park, MD (USA)). 30 Jan 1984. Contract FG43-81R308079. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009390.

The project reported is the remodelling of a house to include an attached greenhouse and a concrete thermal storage wall and cast iron radiators. (LEW)

23675 **(DOE/R3/08091—T1) [Solar laboratory]. Final report.** (Central Montgomery County AVTS, Norristown, PA (USA)). 1984. Contract FG43-81R308091. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009483.

The project reported was to construct and maintain at an area vocational and technical school, a laboratory building that demonstrates state of the art as well as innovative uses of solar energy. Both passive and active features, devices, and equipment were constructed, installed, tested, monitored, and analyzed. (LEW)

23676 **(DOE/R3/08098—T1) Solar-assisted ethanol still. Final technical report.** Pegg, R.J. (Solar American Co., Inc., Newport News, VA). Oct 1982. Contract FG43-81R308098. 26p. NTIS, PC A03. File Number DE85009381.

The Solar American Company, Inc. has successfully adapted a vapor compression solar-assisted heating system to the distillation of ethanol. The system is a hybrid heat pump/solar collector combination in which solar collectors replace the outside air heat exchanger found in conventional air-to-air heat pump systems. The solar panels ordinarily operate at or below ambient temperature thus eliminating the need to install the collector panels in a glazed and insulated enclosure. Solar energy absorbed by exposed panels directly vaporizes the refrigerant fluid. The resulting vapor is compressed to a higher temperature and pressure; then, it is condensed to release the heat absorbed during the vaporization process in a still under vacuum conditions. In the absence of solar input, the panel temperature will drop, and significant amounts of energy will be extracted from the ambient air by convection, radiation, and consensation of moisture. The experimental program which resulted in the fabrication and successful operation of a solar-assisted vapor compression ethanol heater is outlined.

23677 **(DOE/R3/08106—T1) Analysis of three solar energy conversion systems. Final report.** DeVore, P.W.; Summers, E.D. (West Virginia Univ., Morgantown (USA)). Dec 1982. Contract FG43-81R308106. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85009387.

Research was conducted in a dynamic real-life environment involving people living in an urban homestead, called TERAD House, which had been retrofitted to provide people with an ongoing demonstration of residential energy conservation measures. The goal of the research was to evaluate the thermal performance of three solar conversion systems designed for and installed on TERAD House; (1) domestic solar water heating, (2) direct gain wall, and (3) thermosiphoning air panel. To accomplish the goal it was necessary to develop experimental designs that would enable collection of accurate and valid data on the performance of each system over time while each system was operated by residents of the dwelling as part of their day-to-day living. The ultimate objective of the research and the TERAD House project was to change attitudes and values about housing and energy by enhancing the diffusion of valid and appropriate solar systems and conservation practices in Appalachia. A listing of the program used to monitor the direct gain wall is included.

23678 **(SAND—85-0556C) Design and operation of solar thermal heat transfer systems.** Rush, E.E. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 6p. (CONF-850343—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009837.

From SOLERAS - workshop on solar applications in rural locations; Las Cruces, NM, USA (11 Mar 1985).

The importance of heat transfer systems in the collection and use of solar energy is discussed. The success or failure of many solar energy systems has been determined by the design of the heat transfer system. This report includes a short summary of some of the DOE sponsored solar industrial process heat sites. From the design, construction, and operation of these systems many lessons were learned which will be important to designers and potential users of solar thermal systems. Also included is a discussion of solar collector foundation over-design that has increased the collector system costs.

23679 **(SERI/TP—253-2672) Low cost solar water and space heating systems.** Kutscher, C.F. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1985. Contract AC02-83CH10093. 10p. (CONF-850388—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000516.

From Solar buildings: realities for today - trends for tomorrow; Washington, DC, USA (18 Mar 1985).

A number of potential means for equipment and labor cost reductions are presented. The use of drainback systems with polybutylene pipe and a variety of low-cost collector concepts is discused. The pros and cons of the various drainback configurations are described in terms of performance and potential for cost reduction. The use of integrated collector/storage (ICS) systems was also studied.

23680 **(VTT-TUTK—287) Performance of a small house with solar and heat pump heating.** Kalema, T.; Palm, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Jun 1984. 59p. (In Finnish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751473.

The annual energy balance and performance of different components of a small house heating system has been measured during 1 April 1982-31 March 1983 in Forssa in sourthern Finland. The basic energy source is an earth heat pump and resistance heaters are a complementary energy source. The total solar collector area is 30 msup of which 7 msup is used for heating of ventilating air and 23 msup for energy transfer to water storage. Heat is distributed into rooms with warm air through hollow floor slabs. The ventilation is mechanical with heat recovery from exhaust air to fresh air. The annual electricity consumption of heating was 9 500 kWh and of household 6 600 kWh. The heating energy is about 25% less than in new small houses with direct electrical heating. The energy saving is mainly due to the earth heat pump. The energy extracted from earth was 9 000 kWh and the annual coeffi-

cient of performance about 2.6. The energy obtained from solar collectors was quite low. The useful energy to water storage was 1 100 kWh and to heating of ventilation air about 2 000 kWh. During the measurements there were problems with the control system and leakages in the earth pipes.

23681 Free convective turbulent flow within the trombe wall channel. Borgers, T.R.; Akbari, M. (Lawrence Berkeley Laboratory, Berkeley, CA). *Solar Energy;* 33: No. 3/4, 253-264(1984).

A study of free convective turbulent heat transfer between parallel plates has been made. The initial flow is assumed to remain laminar until a combination of geometry, temperature, and flow rate conditions reach a pre-defined level. At this point the model used in this study assumes transition and permits laminar flow to gradually develop into fully turbulent flow. Turbulent flow characteristics are predicted by a mixing length model which incorporates empirical parameters used in the literature. Using air as the fluid, a wide range of channel geometries, relative surface temperatures, and flow rates have been examined. Guided by the very limited available experimental data, computations were made and several correlations were developed to enable important quantities to be estimated given the channel geometry, surface temperatures, and inlet air temperature.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 23661

23682 (CONF-850388—6) Advanced evacuated tube collectors. Schertz, W.W.; Hull, J.R.; Winston, R.; O'Gallagher, J. (Argonne National Lab., IL (USA); Chicago Univ., IL (USA)). 1985. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010271.

From Solar buildings: realities for today - trends for tomorrow; Washington, DC, USA (18 Mar 1985).

Argonne National Laboratory and The University of Chicago are working on a research and development program to develop an advanced evacuated tube collector that will be suitable for mass production by industry, will compete successfully with conventional flat plate collectors at domestic hot-water (DHW) temperatures, and will be suitable for industrial process heat (IPH) and/or cooling applications. The essence of the design concept for these new collectors is the integration of moderate levels of nonimaging concentration inside the evacuated tube itself. This permanently protects the reflecting surfaces and allows the use of highly reflecting front-surface mirrors with reflectances greater than 95%. Previous fabrication and long-term testing of a proof-of-concept prototype has established the technical success of the concept. Present work is directed toward the development of a manufacturable unit that will be suitable for the widest possible range of applications. Design alternatives include scaling up the original prototype's tube diameter from 5 cm to 10 cm, using an internal shaped-metal concentrating reflector, using a variety of profile shapes to minimize so-called "gap losses" and accommodate both single-ended (two-pass) and double-ended (flow-through) flow geometries, and allowing the use of heat pipes for the absorber tube. Studies are being conducted to identify critical requirements for other components in the most likely intermediate-term systems applications.

23683 (DOE/R3/02449—T1) System design notes for Green Bank Library solar air space heater. (Green Bank Public Library, WV (USA)). Oct 1982. Contract FG43-80R302449. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009413.

The solar air heater described in this note is intended to supply partial space heating for the Green Bank Library during the heating months. The funds supplied through an appropriate technology grant are intended to provide a demonstration for the general public and libraries in other areas.

23684 (DOE/R3/06045—T1) Concentrating solar collector system. Final report. Mingo, R.D. (Mingo (Roger D.), Washington, DC (USA)). 30 Aug 1981. Contract FG43-79R306045. 4p. NTIS, PC A02. File Number DE85009149.

A brief report on a solar heat-collecting system for home use is presented. The primary objective of the project was to test the feasibility of using low-cost materials to construct an efficient collector. The system includes a single, large, homemade roof-mounted collector, two heat storage tanks, a moderately complex control unit, and circulating pumps. During operation the heating system provided approximately 60% of the domestic hot water needs for a family of five. (BCS)

23685 (DOE/R3/06057—T1) Inverted flat plate solar collector. Final report. Brown, M.A. (Brown (Michael A.), Columbia, MD (USA)). 26 Aug 1981. Contract FG43-79R306057. 50p. NTIS MF A01; 2; GPO Dep. File Number DE85009259.

Construction and testing of an inverted flat plate solar collector are described. Heat transfer and economic analysis were performed to optimize the collector design. The newly designed collector was tested against two other flat plate collectors and the results and comparison of efficiencies are presented. (BCS)

23686 (DOE/R3/06068—T1) [Vapor phase insulated collector]. Final report. Deakin, D. (Universal Engineering Co., Gaithersburg, MD (USA)). 18 Sep 1981. Contract FG43-79R306068. 11p. NTIS, PC A02. File Number DE85009156.

The final evaluation of the vapor phase insulated collector by DSET Laboratories, Phoenix, Arizona, yielded an efficiency rating which is about the highest of any solar collector panel in its category (flat plate) and did so under some very adverse conditions. As work began on the collector, considerable additional research was done before the actual construction of the panel was begun, and several new approaches were taken as a result of these findings. Considerable time was required to evaluate and test these new variations and the final prototype incorporated some of these changes, however, there was not enough time or funding to pursue all of them as the author would have liked. Therefore, it is felt that, although the results were excellent, a better product is still possible at a much lower price.

23687 (DOE/R3/06074—T1) Foamglass solar window collector. Final report. Grande, P.C. (Grande (Peter C.), Phoenixville, PA (USA)). [1985]. Contract FG43-79R306074. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009197.

Solar heating of a living area by means of a foamglass window collector is reported. The collector was built with readily available materials, and the payback period was found to be 3.7 years.

23688 (DOE/R3/06076—T1) [Filament grid project]. Final report. Anderson, A.R. (Anderson (A. Ray), Three Springs, PA (USA)). 28 Aug 1981. Contract FG43-79R306076. 56p. NTIS, PC A04. File Number DE85009195.

The filament grid concept began prior to the grant award as attested to in the OERI descriptive materials. Initially, to prove the concept viable, two small identical panels were constructed-one with grids; one without. As shown in the body of this report the grid idea improved performance. The concrete heat storage module offers an alternative to rock bin storage and could become a standard building component. Following the on site visit by DOE, July 1980 the program was extended for one year. This permitted construction of improved collectors and work with water heating and dehumidification. Initial water heating did not function as predicted. Subsequent arrangements worked but could not withstand pressure. The working model functions but is very expensive. The water heater is unique in being freeze proof, uses no chemical solutions and requires no drain dows provisions. The water heating/dehumidification unit seems to occupy a place of its own among solar installations. The filament grid collection system is designed for year round use based on heating priority-living space, water, food drying, hair drying, clothes drying or storage for later use.

23689 **(DOE/R3/06095—T1) Fin-tube solar collector development project. Final report.** (Northrub and Associate, Hollidaysburg, PA (USA)). 30 Dec 1980. Contract FG43-79R306095. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009191.

The design, construction, and testing of a laboratory type solar collector are reported. The collector was constructed from fin-tube baseboard heating elements and connected to a test setup for data acquisition under expected operating conditions. Structural designs of the collector are illustrated. (BCS)

23690 **(DOE/R3/08088—T1) Ceramic materials for solar collectors. Final report.** Ankeny, A.E. (Ankeny (Alan E.), Philadelphia, PA (USA)). 29 Sep 1982. Contract FG43-81R308088. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009251.

The purpose of this project was to identify ceramic materials which exhibit solar absorption properties which are appropriate for flat plate solar collectors. To accomplish this, various glaze formulations and clay combinations were produced and evaluated for their potential as solar absorbers. For purposes of comparison a black coated copper sheet was also tested concurrently with the ceramic materials. Thirty-five different coatings were prepared on fifty-six tiles. Two different clays, a porcelain and a stoneware clay, were used to make the tiles. From the tiles prepared, thirty of the most promising coatings were chosen for evaluation. The test apparatus consisted of a wooden frame which enclosed four mini-collectors. Each mini-collector was a rectangular ceramic heat exchanger on which a test tile could be mounted. The working fluid, water, was circulated into the collector, passed under the test tile where it gained heat, and then was discharged out of the collector. Thermometers were installed in the inlet and discharge areas to indicate the temperature increase of the water. The quantity of heat absorbed was determined by measuring the water flow (pounds per minute) and multiplying it by the temperature increase (°F). The control sample, a copper wheet painted flat black, provided a base by which to compare the performance of the test tiles installed in the other three mini-collectors. Testing was conducted on various days during August and September, 1982. The test results indicate that coatings with very satisfactory solar absorbing properties can be made with ceramic materials. The results suggest that an economically viable ceramic solar collector could be constructed if engineered to minimize the effects of relatively low thermal conductivity of clay.

23691 **(NBS-GCR—84-459) Solar collector test procedures: development of a method to refer measured efficiencies to standardized test conditions.** Thomas, W.C. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mechanical Engineering). Feb 1984. 149p. (VPI-E—80.23). NTIS, PC A07/MF A01. File Number DE85901216.

An analytical procedure has been developed for referring collector efficiency measurements, obtained under different test conditions, to a common, or standard set of conditions. The procedure applies to flat-plate liquid-type collectors of conventional tube-in-sheet design. The basic Hottel-Whillier-Bliss theory is used with appropriate extensions to account for serpentine flow configurations and glazing materials with high infrared transmittance. The procedure includes a systematic method for deriving two invariant collector parameters directly from ASHRAE Standard 93-77 test results. The two parameters selected are the plate absorptance and back loss coefficient. A set of standard conditions is recommended which corresponds to favorable test conditions. Experiments were conducted, to evaluate the analytical procedure, on two collectors curves. The results were more consistent for the carefully-controlled research experiments than for routine ASHRAE Standard 93-77 tests at a commercial laboratory. The analytical model provides an effective basis for identifying questionable test data. The analytical correction procedure also applies to alternate test methods for generating flat-plate collector efficiency curves. Experiences and results are described where the test procedure consisted of measuring optical efficiencies and heat losses separately.

23692 **(SAND—81-8188) Plastic heliostat and heliostat enclosure analysis. Final report.** Berry, M.J. (Boeing Engineering and Construction Co., Seattle, WA (USA)). Dec 1984. Contract AC04-76DR00789. 187p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85009112.

The conceptual design and cost analysis report of an enclosed plastic heliostat for a 50-MW/sub e/ central receiver solar thermal electric power plant are presented. The purpose of the study was to analyze the most recent design of the Boeing enclosed plastic heliostat for cost and compare results with a reference second generation glass heliostat case provided by Sandia National Laboratories, Livermore (SNLL). In addition, sensitivities of busbar energy costs to variations in capital cost (installed cost), operation and maintenance cost and overall reflectivity were evaluated.

23693 **(SAND—85-8176) Receiver loss study; optics of optimized solar central receiver systems as a function of receiver thermal loss per unit area. Final report.** Pitman, C.L.; Vant-Hull, L.L. (Houston Univ., TX (USA). Energy Lab.). Mar 1985. Contract AC04-76DP00789. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85010831.

Recent efforts in solar central receiver research have been directed toward high temperature applications. Associated with high temperature processes are greater receiver thermal losses due to reradiation and convection. This report examines the performance of central receiver systems having optimum heliostat fields and receiver aperture areas as a function of receiver thermal loss per unit area of receiver aperture. The results address the problem of application optimization (where the loss per unit area varies) as opposed to the problem of merely optimizing a design for a specific application (where the loss per unit area is approximately fixed). A reasonable range of values for the primary independent variable L (the average reradiative and convective loss per unit area of receiver aperture) and a reasonable set of design assumptions were first established. The optimum receiver aperture area, number and spacings of heliostats, and field boundary were then determined for two tower focal heights and for each value of L. From this, the solar subsystem performance for each optimized system was calculated. Heliostat field analysis and optimization required a detailed computational analysis. A significant modification to the standard method of solving the optimization equations, effectively a partial decoupling of the solution process into collector and receiver subsystem parts, greatly aided the analysis. Results are presented for tower focal heights of 150 and 180 m. Values of L ranging from 0.04 to 0.50 MW/m^2 were considered, roughly corresponding to working fluid temperatures (at receiver exit) in the range of 650 to 1650 C. As L increases over this range, the receiver thermal efficiency and the receiver interception factor decrease. The optimal power level drops by almost half, and the cost/unit of energy produced increases by about 25% for the base case set of design assumptions.

23694 **(SAND—85-8206) Thermal performance and design of a solid particle cavity receiver.** LaJeunesse, C.A. (Sandia National Labs., Livermore, CA (USA)). Apr 1985. Contract AC04-76DR00789. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010830.

A model for energy transport in a solid particle cavity receiver is developed and applied to the design and analysis of a receiver for the Central Receiver Test Facility (CRTF), Albuquerque, New Mexico. The model gives thermal performance results - including particle temperatures, cavity efficiencies, and wall temperatures - which directly affect the economic and technical feasibility of a solid particle receiver. In addition, design criteria relevant to the configuration of a solid particle cavity receiver are developed. Results for CRTF indicate that at design conditions particle temperatures will exceed 1200°K with cavity efficiencies on the order of 75%.

23695 **Two stage linear Fresnel lenses.** Kritchman, E.M. (Elscint Ltd., Advanced Technology Center, Haifa). *Solar Energy;* **33**: No. 1, 35-39(1984).

A new design of a second stage reflective element, which is closely related to the earlier trumpet configuration, is presented. The implementation for linear Fresnel lenses is derived, leading to high solar concentration with both convex and flat lenses.

23696 **Dependence of ground heat loss upon solar pond size and perimeter insulation calculated and experimental results.** Hull, J.R.; Kamal, J.; Liu, K.V.; Nielsen, C.E.; Sha, W.T. (Argonne National Laboratory, Argonne, IL). *Solar Energy;* 33: No. 1, 25-33(1984).

Ground heat losses from solar ponds are modelled numerically for various perimeter insulation strategies and several solar pond sizes. The numerical simulations are steady state calculations of heat loss from a circular or square pond to a heat sink at the outer boundaries of an earth volume that surrounds the pond on the bottom and sides. Simulation results indicate that insulation on top of the ground around the pond perimeter is rather ineffective in reducing heat loss, and that uninsulated sloping side walls are slightly more effective than insulated vertical side walls, except for very small ponds. The numerical results are used to derive coefficients for a semi-empirical equation describing ground heat loss as a function of pond area, pond perimeter and insulation strategy. Experimental results for ground heat loss and energy balance in the 400 m^2 solar pond at the Ohio State University are reported. Analysis of this data, along with data on solar energy input, heat gain by the pond, heat loss through the gradient zone, and heat extraction from the pond yields a good energy balance. Numerical simulation of ground heat loss from this pond shows good agreement with the results obtained from pond measurements. Loss turns out to be large because of unexpectedly high values of earth thermal conductivity in the region.

1420 Heat Storage

REFER ALSO TO CITATION(S) 23649, 23651, 23945

23697 **(SERI/TP—252-2569) High temperature sensible heat storage options.** Wang, K.Y.; Kreith, F.; West, R.E.; Lynn, P. (Solar Energy Research Inst., Golden, CO (USA); Colorado Univ., Boulder (USA). Dept. of Chemical Engineering; Lynn (P.P.), Inc., Boulder, CO (USA)). Nov 1984. Contract AC02-83CH10093. 9p. (CONF-850306—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85000534.

From Solar energy conference--1985; Knoxville, TN, USA (25 Mar 1985).

Design options and operation criteria for sensible heat molten salt storage with internal insulation are presented. Raft thermocline, two-tank, and two-media thermocline systems are the concepts discussed. Regenerative cooling, bottom insulation, and thermocline stability are considered in the thermal analysis. A brief discussion of the technical risks of each tank system is included. Cost estimations are also provided.

23698 **(SERI/TR—231-2593) SERI Solar Energy Storage Program: FY 1984 annual report.** Luft, W.; Bohn, M.; Copeland, R.J.; Kreith, F.; Nix, R.G. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1985. Contract AC02-83CH10093. 43p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85002936.

This report summarizes the activities of the Solar Energy Research Institute's Solar Energy Storage Program during its sixth year. During FY 1984 a study was conducted to identify the most promising high-temperature containment concepts considering corrosion resistance, material strength at high temperature, reliability of performance, and cost. Of the two generic types of high-temperature thermal storage concepts, the single-tank system was selected using a two-medium approach to the thermocline maintenance. This concept promises low costs, but further research is required. a conceptual design for a sand-to-air direct-contact heat exchanger was developed using dual-lock hoppers to introduce the sand into the fluidized-bed exchanger, and using cyclones to remove sand particles from the output air stream. Preliminary cost estimates indicate heat exchanger subsystem annual levelized costs of about $4/GJ with compressor costs of an additional $0.75/GJ. An economic analysis comparing sensible and latent heat storage for nitrate and carbonate salts with solely sensible heat storage showed 3%-21% cost savings with combined sensible and latent heat storage. Our thermochemical research was terminated in FY 1984.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 23608

23699 **(CONF-8410179—) Geothermal Program Review III: proceedings.** (Energy Technology Engineering Center, Canoga Park, CA (USA)). 1984. Contract AM03-76SF00701. 359p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85008202.

From DOE geothermal technology conference; El Centro, CA, USA (16 Oct 1984).

Separate abstracts were prepared for individual papers. (MHR)

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 23934

23700 **(LBL—18232) Melt zones beneath five volcanic complexes in California: an assessment of shallow magma occurrences.** Goldstein, N.E.; Flexser, S. (Lawrence Berkeley Lab., CA (USA)). Dec 1984. Contract AC03-76SF00098. 136p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85010644.

Recent geological and geophysical data for five magma-hydrothermal systems were studied for the purpose of developing estimates for the depth, volume and location of magma beneath each area. The areas studied were: (1) Salton Trough, (2) The Geysers-Clear Lake, (3) Long Valley caldera, (4) Coso volcanic field, and (5) Medicine Lake volcano, all located in California and all selected on the basis of recent volcanic activity and published indications of crustal melt zones. 23 figs.

1502 Geology And Hydrology Of Geothermal Systems

23701 **(DOE/BP—272) Survey of potential geothermal exploration sites at Newberry volcano, Deschutes County, Oregon.** Priest, G.R.; Vogt, B.F.; Black, G.L. (eds.). (Oregon Dept. of Geology and Mineral Industries, Portland (USA)). 1983. Contract AC79-82BP36734. 196p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85008052.

The study summarizes the current data, generates some new data, and recommends further steps which should be taken to investigate the electrical power production potential of Newberry volcano. The objective was to concentrate on data from the developable flanks of the volcano. All previous data on the geology, hydrology, and geophysics were summarized. A soil-mercury survey focused on the flanks of the volcano was conducted. Samples from 1000 km^2 of the volcano were analyzed for mercury content. All this information was utilized to evaluate (1) the likelihood of future discovery of electrical-quality geothermal fluids on the flanks, and (2) the most cost-effective means of improving the quality of available power generation estimates for the volcano. 37 figures.

23702 **(DOE/ET/27111—T6) Depositional setting, structural style, and sandstone distribution in three geopressured geothermal areas, Texas Gulf Coast.** Winker, C.D.; Morton, R.A.; Ewing, T.E.; Garcia, D.D. (Texas Univ., Austin (USA). Bureau of Economic Geology). 1983. Contract AC08-79ET27111;AS05-76ET28461. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009787.

Three areas in the Texas Gulf Coastal Plain were studied using electric logs and seismic-reflection data to interpret their depositional and structural history and to compare their potential as geopressured-geothermal reservoirs. The Cuero study area, on the lower Wilcox (upper Paleocene) growth-fault trend, is characterized by closely and evenly spaced, subparallel, down-to-the-basin growth faults, relatively small expansion ratios, and minor block rotation. Distributary-channel sandstones in the geopressured lower Wilcox Group of the South Cook fault block appear to be the best geothermal aquifers in the Cuero area. The Blessing study area, on the lower Frio (Oligocene) growth-fault trend, shows wider and more variable fault spacing and much greater expansion ratios and

block rotation, particularly during early Frio time. Thick geopressured sandstone aquifers are laterally more extensive in the Blessing area than in the Cuero area. The Pleasant Bayou study area, like the Blessing area, is on the Frio growth-fault trand, and its early structural development was similar rapid movement of widely spaced faults resulted in large expansion ratios and major block rotation. However, a late-stage pattern of salt uplift and withdrawal complicated the structural style. Thick geopressured lower Frio sandstone aquifers are highly permeable and laterally extensive, as in the Blessing area. In all three areas, geopressured aquifers were created where early, rapid movement along down-to-the-basin growth faults juxtaposed shallow-water sands against older shales, probably deposited in slope environments. Major transgressions followed the deposition of reservoir sands and probably also influenced the hydraulic isolation that allowed the build up of abnormal pressures. 26 refs., 49 figs., 8 tabs.

23703 **(DOE/ID/12026—T10) Preliminary heat flow estimates for Wyoming and Montana.** Decker, E.R.; Heasler, H.P. (Maine Univ., Orono (USA). Dept. of Geological Sciences; Wyoming Univ., Laramie (USA). Dept. of Geology). Jan 1985. Contract FC07-79ID12026. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010256.

A table is presented containing basic thermal data for preliminary heat flow estimates in Wyoming and Montana. The thermal data include thermal conductivities of rock samples from drill holes, temperature gradients, depth ranges for the least-squares calculation of the temperature gradients, and the computed heat flow values. Other data listed the country code, the locality, and the elevation of each drill hole.

23704 **(USGS-OFR—81-918) Geothermal resources of the western arm of the Black Rock Desert, northwestern Nevada. Part I. Geology and geophysics.** Schaefer, D.H.; Welch, A.H.; Maurer, D.K. (Geological Survey, Carson City, NV (USA)). 1983. 90p. US Geological Survey, Box 25245, Denver Federal Center, Denver, CO 80225. File Number TI85901286.

Studies of the geothermal potential of the western arm of the Black Rock Desert in northwestern Nevada included a compilation of existing geologic data on a detailed map, a temperature survey at 1-meter depth, a thermal-scanner survey, and gravity and seismic surveys to determine basin geometry. The temperature survey showed the effects of heating at shallow depths due to rising geothermal fluids near the known hot spring areas. Lower temperatures were noted in areas of probable near-surface ground-water movement. The thermal-scanner survey verified the known geothermal areas and showed relatively high-temperature areas of standing water and ground-water discharge. The upland areas of the desert were found to be distinctly warmer than the playa area, probably due to the low thermal diffusivity of upland areas caused by low moisture content. Surface geophysical surveys indicated that the maximum thickness of valley-fill deposits in the desert is about 3200 meters. Gravity data further showed that changes in the trend of the desert axis occurred near thermal areas. 53 refs., 8 figs., 3 tabs.

23705 **(USGS-OFR—83-431A) Idaho: basic data for thermal springs and wells as recorded in GEOTHERM, Part A.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). Jul 1983. 64p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85900474.

All chemical data for geothermal fluids in Idaho available as of December 1981 is maintained on GEOTHERM, computerized information system. This report presents summaries and sources of records for Idaho. 7 refs. (ACR)

23706 **(USGS-OFR—83-433A) Nevada: basic data for thermal springs and wells as recorded in GEOTHERM. Part A.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). Jun 1983. 102p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901252.

All chemical data for geothermal fluids in Nevada available as of December 1981 are maintained on GEOTHERM, a computerized information system. This report presents summaries and sources of records for Nevada. 7 refs. (ACR)

23707 **(USGS-OFR—83-436) Texas: basic data for thermal springs and wells as recorded in GEOTHERM.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). Jul 1983. 437p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901334.

This compilation identities all locations of potential source of geothermal fluids in Texas available as of December 1981. 7 refs. (ACR)

23708 **(USGS-OFR—84-287) Geothermal resources of Sao Miguel Island, Azores, Portugal.** Duffield, W.A.; Muffler, L.J.P. (Geological Survey, Flagstaff, AZ (USA); Geological Survey, Menlo Park, CA (USA); Geological Survey, Denver, CO (USA); Geological Survey, Volcanoes National Park, HI (USA)). 1984. 22p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901331.

Geothermal studies were carried out on the island of Sao Miguel, Azores to characterize the nature of the resource, to estimate its magnitude, and to identify target areas toward which exploration and developmental drilling might be directed. The main geothermal resource areas are Furnas, Agua de Pau, and Sete Cidades, three Quaternary silicic volcanic centers characterized by summit calderas beneath which magmatic heat sources provide thermal energy to overlying hydrothermal convection systems. For each of the systems, the studies have defined the size of the system, the subsurface temperature, the thermodynamic state of fluid in the system, the chemical composition of the fluid, and permeable parts of the system. 8 figs. (ACR)

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 23700, 23704, 23716

23709 **(NMERDI—2-65-2164) Evaluation of geothermal potential of Rio Grande rift and Basin and Range province, New Mexico. Final technical report, January 1, 1977-May 31, 1978.** Callender, J.F. (New Mexico Univ., Albuquerque (USA). Dept. of Geology). Apr 1985. 281p. NTIS, PC A13/MF A01 - NMERDI-Univ. of New Mexico, Suite M, 457 Washington S.E., Albuquerque, NM 87108. File Number DE85901380.

A study was made of the geological, geochemical and geophysical characteristics of potential geothermal areas in the Rio Grande rift and Basin and Range province of New Mexico. Both regional and site-specific information is presented. Data was collected by: (1) reconnaissance and detailed geologic mapping, emphasizing Neogene stratigraphy and structure; (2) petrologic studies of Neogene igneous rocks; (3) radiometric age-dating; (4) geochemical surveying, including regional and site-specific water chemistry, stable isotopic analyses of thermal waters, whole-rock and mineral isotopic studies, and whole-rock chemical analyses; and (5) detailed geophysical surveys, using electrical, gravity and magnetic techniques, with electrical resistivity playing a major role. Regional geochemical water studies were conducted for the whole state. Integrated site-specific studies included the Animas Valley, Las Cruces area (Radium Springs and Las Alturas Estates), Truth or Consequences region, the Albuquerque basin, the San Ysidro area, and the Abiquiu-Ojo Caliente region. The Animas Valley and Las Cruces areas have the most significant geothermal potential of the areas studied. The Truth or Consequences and Albuquerque areas need further study. The San Ysidro and Abiquiu-Ojo Caliente regions have less significant geothermal potential. 78 figs., 16 tabs.

23710 **(USGS-OFR—83-428A) California: basic data for thermal springs and wells as recorded in GEOTHERM. Part A.** Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). Jul 1983. 109p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901337.

This GEOTHERM sample file contains 1535 records for California. Three computer-generated indexes give one line summaries of each GEOTHERM record. Each index is sorted by different variables to assist in locating geothermal records describing specific sites. 7 refs. (ACR)

23711 (USGS-OFR—83-440) Central and eastern United States: basic data for thermal springs and wells as recorded in GEOTHERM. Bliss, J.D. (Geological Survey, Menlo Park, CA (USA)). Jun 1983. 102p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901336.

The GEOTHERM sample file contains 119 records for the central and eastern United States. The records contain data on location, sample description, analysis type, collection condition, flow rates, and the chemical and physical properties of the fluid. Stable and radioisotopic data are occasionally available. 7 refs. (ACR)

1505 Economic And Financial Aspects

23712 (EGG-M—08485) Geothermal district heating: basics to success. Lunis, B.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 6p. (CONF-850801—27). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009885.

From International symposium on geothermal energy; Kailua Kona, HI, USA (26 Aug 1985).

A district heating system using geothermal energy is a viable and economic option in many locations. A successful system, however, is dependent upon a variety of factors, and it is the purpose of this presentation to accent those items that are proving to have significant impact upon the successful operation of geothermal district heating systems. (These lessons can also apply to other sources of energy.) The six major basics to success that are discussed in this paper are economic viability, an adequate geothermal resource, simplicity of design, a closed loop system, a local champion, and good public relations.

1506 Environmental Aspects And Waste Disposal

23713 (DOE/NV/10174—4) Technical support for geopressured-geothermal well activities in Louisiana. Annual report, 1 November 1982-31 October 1983. (Louisiana Geological Survey, Baton Rouge (USA)). 31 Oct 1984. Contract AC08-81NV10174. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85010462.

This annual report describes environmental monitoring of microseismic activity, land-surface elevations, and surface and ground-water quality at three designed geopressured-geothermal test well sites in Louisiana.

23714 (HNEI—84-S01) Geothermal hydrogen sulfide and health in Rotorua, New Zealand. Siegel, S.M.; Siegel, B.Z. (Hawaii Univ., Honolulu (USA). Hawaii Natural Energy Inst.). 15 Feb 1984. 37p. (CONF-8402143—1). NTIS, PC A03/MF A01. File Number DE85901283.

From Symposium on geothermal energy for New Zealand's future; Rotorua, New Zealand (1 Feb 1984).

Rotorua, New Zealand, lies inside a volcanic caldera. Natural steam is extensively used for space and water heating, and electric power generation. This report presents results of a preliminary reconnaissance survey of atmospheric H_2S levels in the area and attempts to relate these levels to health statistics in the region. 5 refs., 8 tabs. (ACR)

1509 Geothermal Engineering

23715 (LA—10347-HDR) Hot Dry Rock Geothermal Energy Development Program. Annual report, fiscal year 1983. Smith, M.C.; Nunz, G.J.; Wilson, M.G. (comps.). (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 96p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85010570.

Emphasis was on hydraulic-fracturing experiments at depths around 3.5 km (11,473 ft) in the two inclined wells of the Phase II system at Fenton Hill, New Mexico; on improved facilities and techniques for mapping the source locations of acoustic signals generated by the fracturing events; on mathematical modeling of the fracture systems produced in these and earlier experiments; and on development of a family of slimline high-temperature downhole instruments that can be used within or through relatively small-diameter pressure tubing. Hydraulic fracturing at a vertical depth of approximately 3500 m (11,500 ft) in well EE-2, the deeper well, produced fractures that, in acoustic maps, appear to occupy a large, roughly ellipsoidal volume whose major axis is directed to the north of the other well, EE-3. Hydraulic fracturing from EE-3 at a similar depth produced another set of fractures that appear to be approximately parallel to and centered about 180 m (600 ft) east of the earlier set. Subsequent fluid injections reduced the distance between the two sets, but no hydraulic connection between them was established. Modeling the silica concentrations of fluid circulated through the earlier Phase I system indicates that this type of permeation also contributes significantly to heat extraction during system operation. The precision and accuracy of locating the sources of acoustic signals detected during hydraulic-fracturing operations have been increased by improvements in equipment, drilling of another deep hole for geophone emplacement, and additional station calibrations. Analysis of the signals has also been improved and broadened. Development of slimline downhole instruments has included a detonator tool, a geophone package, and final design of a high-temperature borehole acoustic televiewer. A crosswell acoustic transceiver has also been developed for investigating rock type and structure between wellbores. 32 refs., 35 figs.

23716 (SAND—84-0288) Workshop on borehole measurements and interpretation in scientific drilling - identification of problems and proposals for their solution: proceedings. Cooper, D.L.; Traeger, R.K. (eds.). (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 123p. (CONF-8311148—). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE84010626.

From Workshop on borehole measurements and interpretation in scientific drilling: identification of problems and proposals for their solution; Albuquerque, NM, USA (15 Nov 1983).

Critical instrumentation needs for borehole-oriented, geoscience research were identified in a program consisting of formal presentations, psoter sessions and a workshop. The proceedings include results of the workshops, abstracts of the papers and poster sessions, and the attendance list. Details of any of the presentations should be obtained from the individual authors. Separate entries were prepared for individual presentations.

1510 Direct Energy Utilization

REFER ALSO TO CITATION(S) 23680

16 Wave Energy Converters

REFER ALSO TO CITATION(S) 23654, 23655

17 WIND ENERGY

REFER ALSO TO CITATION(S) 23608

23717 (ESC-WR—85-04) Collection of performance data of wind turbines 1983/1984. Gerbers, D. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Feb 1985. 163p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The project 'Collection of performance data of wind turbines 1983/1984' aims to collect data on wind turbines in The Netherlands and storing them into a database. These data could give better insight into the economic feasibility of wind energy. Stored data are: type and trade mark with technical specifications; location; character of the organization using the wind turbine; financial data as investment, subsidies, costs and profits; licensing, procedures, managing and administration; break-down; and environmental aspects and nuissance. Data are collected by the organization

'Energie Anders' and processed by Energie Studie Centrum (ESC). (A.V.)

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 23725

23718 **(STEV-VIND—84-23) Wind conditions along the Swedish coast. Quarterly report 4/1984.** Kvick, T.; Andersson, H. (Statens Energiverk, Stockholm (Sweden)). Jun 1984. 46p. (In Swedish). (SMHI-MK—1984-19). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751416.

Offshore wind conditions along the Swedish coast have been analysed from available wind measurements and simulations by a dynamic wind-field model. The available wind data are primarily from eight offshore light houses. These measurements are made at 25-35 m above the sea level. The dynamic wind field model used is a two-dimensional, one-level primitiv equation-model. To characterize the greater scale we have used the geostrophic wind, obtained from the pressure field, and the temperature- and geopotential field from surface, 850 and 700 mb-levels. The properties of the smaller scale are described by digitalizing the topogrphy and the surface roughness in a grid. We have used the model to simulate the wind field within two different areas. The first are is 30 x 60 kilometres^2. The gridsize is 1 km ^{2} with 1800 calculation points. The simulations has ben made for every six hours during one year. Continous measurements have been made at 50 m height, at one site of the shore and at one site 10 km offshore. At those two points the model is verified to be capable to describe differences of the long-term wind-field between the two sites. The model seem to calculate to low wind speeds. The second simulation area the southern one-third of Sweden and the grid used is 22 kilometres giving 1845 calculation points. The results can be summarized as follows: The land to sea recovery of the wind speed is mainly taking place within 10-12 kilometres from the shore and the increase in windspeed is, as a mean about 0.8-1.2 m/s. The off-shore median wind speeds are 7.4-8.3 m/s and 8-9 m/s. The wind energy potentials can vary up to + /- 35 % between different offshore areas for other reasons than the distance from the shore. The median wind speeds at the best offshore areas are at least 0.7 m/s higher than at the best on-land sites. That corresponds to 25-35 percent higher energy production.

23719 **(STEV-VIND—84-33) Siting of wind power plants in Sweden.** Skaerbaeck, E. (Statens Energiverk, Stockholm (Sweden)). Oct 1984. 81p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751443.

The possibilites of introducing wind power on a large scale in Sweden have been assessed with regard to wind supply and other land uses in regions that are of interest from the point of view of wind resources. The possibilities of developing a scheme for an energy production of 10 TWh/year have been analysed and appraisals have also been made for a development of 30 TWh/year. A development of 10 TWh/year can be achieved in different ways. However, the wind areas utilized vary considerably depending on choice of strategy and selection of minimum distance to buildings. The number of units differs to a relatively limited extent for the different strategies and different minimum distances to buildings. However, the overall area involved varies considerably. For assessments as to the possibilities of more extensive development there is a potential for 28 TWh/year at a 250 m minimum distance to buildings within the areas with relatively minor opposing interests in combination with relatively good wind supplies.

1704 Economics

23720 **(ECN—85-048) Calculation of the fuel savings at autonomous wind diesel systems as a function of the average wind power.** De Bonte, J.A.N. (Netherlands Energy Research Foundation, Petten). Mar 1985. 24p. ECN, P.O. Box 1, 1755 ZG Petten, The Netherlands.

A consisting method is described to estimate the fuel savings of autonomous wind diesel systems (AWDS) over a long period (year). Verification of these estimations by measurements will take a very long measuring period (years). A faster verification method, which is an extension of the mentioned method, is described in this report. By this method, based on 10 minutes averaged measurements, the fuel savings are calculated as a function of the average wind power, with the load power as parameter. This extension is compared with some results of measurements on the test set of an AWDS in Petten. These measurement results show a good correspondence with the calculated results except near the wind power level where the diesel engine could be stopped according to the theory. The non-correspondence is mainly caused by a bad adjusted frequency control loop of the test set, which causes an extra load on the diesel engine by the additional controllable load, even at a surplus of wind power. (A.V.)

1705 Environmental Aspects

23721 **(SERI/TR—635-1166) Acoustic noise associated with the MOD-1 wind turbine: its source, impact, and control.** Kelley, N.D.; McKenna, H.E.; Hemphill, R.R.; Etter, C.L.; Garrelts, R.L.; Linn, N.C. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1985. Contract AC02-83CH10093. 262p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85002947.

This report summarizes extensive research by staff of the Solar Energy Research Institute and its subcontractors conducted to establish the origin and possible amelioration of acoustic disturbances associated with the operation of the DOE/NASA MOD-1 wind turbine installed in 1979 near Boone, North Carolina. Results have shown that the source of this acoustic annoyance was the transient, unsteady aerodynamic lift imparted to the turbine blades as they passed through the lee wakes of the large, cylindrical tower supports. Nearby residents were annoyed by the low-frequency, acoustic impulses propagated into the structures in which the complainants lived. The situation was aggravated further by a complex sound propagation process controlled by terrain and atmospheric focusing. Several techniques for reducing the abrupt, unsteady blade load transients were researched and are discussed in the report.

23722 **(STEV-VIND—84-34) Preliminary assessment of environmental noise from large WECS, based on experiences from Swedish prototypes.** Ljunggren, S. (Statens Energiverk, Stockholm (Sweden)). Oct 1984. 53p. (FFA-TN—1984-48). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751444.

A discussion of the results of measurements performed at the Swedish WECS prototypes Maglarp and Naesudden is presented. It is shown that the noise levels are close to those measured at similar units in the United States, and that the radiation is uniform in both the vertical and horizontal plane. A comparatively large distance is needed between the prototypes and residential locations if the same basis for forming a judgement is used as for industrial noise. With suitable measures (sound insulation of machinery housing, increased cut-in wind speed, variable rotational speed of turbine) the distance for an upwind unit is reduced to about 300-500 m, provided the masking effect of natural wind sound is taken into account.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 23672, 23719

23723 (DOE/CE—0105, pp 49-54) **Wind.** Nov 1984. NTIS, PC A05/MF A01. File Number DE85001509.

In Renewable technologies program summaries.

The primary technologies of concern to the program are those that convert wind energy to electricity. The program has focussed on the horizontal axis propeller type and the vertical axis Darrieus type wind turbines. The purpose of the Federal Wind Energy Technology program is to perform research that will enable the private sector to develop and utilize safe, reliable, and efficient wind energy systems. The goal of the program is to improve the basic understanding of aerodynamics and structural dynamics in order to more accurately predict wind turbine aerodynamic performance, natural resonance frequencies, and structural loads. A small systems test center at Rocky Flats conducted 14

tests in FY 1983. Further efforts were made to develop advanced multi-megawatt wind turbines.

23724 **(DOE/NASA/20320—62) Development of large, horizontal-axis wind turbines.** Baldwin, D.H.; Kennard, J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; Sverdrup Technology, Middleburg Heights, OH (USA)). Mar 1985. Contract AI01-76ET20320. 13p. (NASA-TM—86950). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010012.

A major segment of the Federal Wind Energy Program sponsored by the Department of Energy (DOE) is the program to develop large, horizontal-axis wind turbines. The NASA Lewis Research Center manages that segment for DOE. The program is directed toward developing the technology for safe, reliable, environmentally acceptable large wind turbines that can generate a significant amount of electricity at costs competitive with those of conventional electricity-generating systems. In addition, these large wind turbines must be fully compatible with electric utility operations and interface requirements. Several ongoing projects in large-wind-turbine development are directed toward meeting the technology requirements for utility applications. The machines based on first-generation technology (Mod-OA and Mod-1) successfully completed their planned periods of experimental operation in June 1982. The second-generation machines (Mod-2) are in operation at selected utility sites. A third-generation machine (Mod-5) is under contract. Erection and initial operation of the Mod-5 in Hawaii should take place in 1986. Each successive generation of technology has increased reliability and energy capture while reducing the cost of electricity. These advances are being made by gaining a better understanding of the system-design drivers, improving the analytical design tools, verifying design methods with operating field data, and incorporating new technology and innovative designs. This report is an overview of the large-wind-turbine activities managed by NASA Lewis. These activities include results from the first- and second-generation machines (Mod-OA, -1, and -2), the status of the Department of Interior WTS-4 machine for which NASA Lewis is responsible for technical management, and the status of the third-generation wind turbine (Mod-5).

23725 **(DOE/R3/02433—T1) [Adopt-an-Anemometer Program]. Draft.** Gipe, P.B. (Gipe (Paul B.), Harrisburg, PA (USA)). 1981. Contract FG43-80R302433. 29p. NTIS, PC A03. File Number DE85008984.

The report describes the Adopt-An-Anemometer Program and its implementation in Pennsylvania. The discussion is not limited to Pennsylvania but can be used as an outline for an anemometer loan program elsewhere at either the state or regional level. The management of the program is described in detail including the selection of the participants and the equipment to be used. The performance of this selection process and the equipment chosen is discussed so that others might learn by our mistakes. The report describes the data analysis methodology used and discusses the limitations of data on average wind speeds. It also points out the pitfalls among the techniques currently used to analyze average wind speed data. The report looks at the wind resource data available in Pennsylvania and attempts to infer an energy pattern factor appropriate to the state. The sites used in the program are then described and the data from these sites interpreted. The data from the program is then used to estimate the wind power potential and the economic feasibility of wind machines in the areas under study. Various conditions affecting the economic calculations are taken into account, including machine size, the cost of conventional energy, and the potential users' tax status. Recommendations are made for those who would like to set up similar programs in other areas and who would like to improve upon our experience. The Appendix offers instructions on how to install an anemometer and gives several examples of the correspondence used in the program.

23726 **(DOE/R3/06052—T1) [Wind turbine]. Final quarterly project report, January-April 1981.** Racine, W.D. III. (Racine (W. David III), Rehoboth Beach, DE (USA)). 30 Apr 1981. Contract FG43-79R306052. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009735.

A 16 ft diameter wind turbine of fiberglass/foam construction was constructed to drive a 4000W/230 VAC alternator. Data are given on the wind turbine's output. Project expenses are tabulated. (LEW)

23727 **(DOE/R3/06072—T1) 5 kW windmill project. Final report.** Boynton, W.P. (Boynton (W.P.), Northampton, PA (USA)). [1985]. Contract FG43-79R306072. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009423.

The purpose of this project was to construct and demonstrate a 5 kW wind power generator; however, a 4 kW generator was used instead to conserve costs. The system was operated once, but blade speed controller problems forced immediate shutdown. During the 5 minute test the system powered several electrical resistance heaters. It was concluded that commercial potential is probable if mass production techniques could reduce costs. (BCS)

23728 **(DOE/R3/06104—T1) Wind energy on the family farm. Final technical report.** Rosental, J.S. (Rosental (Jerry S.), Louisa, VA (USA)). 30 Sep 1981. Contract FG43-79R306104. 35p. NTIS, PC A03. File Number DE85009151.

This project set out to provide a demonstration of wind energy, irrigation and refrigeration on a family farm. Various inefficiencies have contributed to lower electrical output, as has a lower than expected wind speed. Delays, inflation, unexpected events, and other factors have contributed to substantially higher costs for all phases of the project. The irrigation system has mostly worked well, while the ice pond showed theoretical success. Certain innovative and practical solutions have been achieved, including modifications and repairs to the generator, underground freeze-proof well houses and water storage.

23729 **(ECN—85-032) Universal measuring program UMP.12; program listing.** Wagenaar, M.B.; Stam, W.J. (Netherlands Energy Research Foundation, Petten). Feb 1985. 87p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The data acquisition system for the wind turbine testfield at ECN and for other test facilities at ECN is based on Apple II microcomputers. The listing of the computer code as measuring data collection system, UMP.12, developed for this purpose, is described. (J.C.R.)

23730 **(ECN—85-033) Universal measuring program UMP.12; description.** Wagenaar, M.B.; Stam, W.J. (Netherlands Energy Research Foundation, Petten). Feb 1985. 69p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The data acquisition system for the wind turbine testfield at ECN and for research facilities is based on Apple II microcomputers. The computer code which is used as universal measuring data collection system is described. (J.C.R.)

23731 **(FFA-REPORT—136) Fundamental study of the relation between the velocity fields far upstreams of, at and far downstream of a rotor disk in a shear flow.** Johansson, C.Aa. (Flygtekniska Foersoeksanstalten, Stockholm (Sweden)). Oct 1983. 98p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85751434.

Conventional methods of aerodynamic analysis are not directly applicable to the flow around wind turbines, since the velocity perturbations are large, and the free stream is a shear flow containing vorticity. For the analysis of wind turbine flow, it would be of great value to find a general relation between the local velocity fields far upstream, at the rotor disk and far downstream of a rotor inducing large perturbations (disk or lifting line) is half the induced velocity far downstream at the same streamline. For a rotor in uniform flow, the mean induced velocity at the disk is also half the mean induced velocity far downstream, even if the perturbation velocities are not small. In the present report the desired general relation has not yet been obtained, but hopefully a first step towards it has been taken. A numerical example is calculated, which shows that the ratio one half has no general validity. Due to the fundamental nature of the present study, the results are applicable not only to wind turbines, but also to propellers, helicopter rotors, etc.

23732 (NLR-MP—83054-U) Design criteria for small wind turbines. Van der Linden, H.H. (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands)). Aug 1983. 8p. (In Dutch). (CONF-8309206—1). Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (14 Sep 1983).

Existing regulations result in very conservative design loads. Further, these regulations will not allow for lower design loads when load alleviation concepts are used. Four institutes which are involved in research and development in the field of loads on small wind turbines, defined a cooperative research programme. The objective is to define simple, but less conservative design criteria. The research proposal has been submitted to BEOP (Project Office for Energy Research) in the course of 1983. Starting points, methods and means of accomplishment will be discussed. (J.C.R.)

23733 (NLR-MP—83055-U) Verification of the fatigue properties of (small) wind turbines. Van der Linden, H.H. (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands)). Aug 1983. 10p. (In Dutch). (CONF-8309206—2). Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands.

From National wind energy conference; Noordwijkerhout, Netherlands (14 Sep 1983).

A review is given of the different aspects which play a role in the verification of the fatigue properties of (small) wind turbines: structural analysis, which identifies the fatigue critical areas; determination of load spectra; and establishment of fatigue life by test and analysis. (J.C.R.)

23734 (SAND—84-1287) Structural design of the Sandia 34-meter Vertical-Axis Wind Turbine. Berg, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1985. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011146.

Sandia National Laboratories, as the lead Department of Energy laboratory for Vertical-Axis Wind Turbine development, is currently designing a 34-m diameter Darrieus-type vertical-axis wind turbine. This turbine will be a research test bed that provides a focus for advancing technology and validating design and fabrication techniques in a size range suitable for utility use. Structural data from this machine will allow structural modeling to be refined and verified for a turbine on which the gravity effects and stochastic wind loading are significant. Performance data from it will allow aerodynamic modeling to be refined and verified. This design effort incorporates Sandia's state-of-the-art analysis tools in the design of a complete machine. This report describes the analytic tools being used, summarizes the conceptual design procedure, and presents portions of the detailed design as it existed in September 1984.

23735 (SERI/STR—217-2559) Post-stall wind tunnel data for NACA 44XX series airfoil sections. Ostowari, C.; Naik, D. (Texas A and M Univ., College Station (USA). Dept. of Aerospace Engineering). Jan 1985. Contract AC02-83CH10093. 179p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85002948.

Wind turbine blades operate over a wide angle of attach range. Unlike aircraft, a wind turbine's angle of attach range extends deep into stall where the three-dimensional performance characteristics of airfoils are not generally known. Peak power predictions upon which wind turbine components are sized depend on a good understanding of a blade's post-stall characteristics. The purpose of this wind tunnel study is to characterize the performance characteristics of a blade in stall as a function of its aspect ratio, airfoil thickness, and Reynolds number. This report documents results of the wind tunnel investigation of constant chord blades having four aspect ratios, with NACA 44XX series airfoil sections, at angles of attack ranging from -10° to 110°. Tests were conducted at Reynolds number ranging from 0.25 x 106 to 1.0 x 106. The thickness ratios studied were 0.18, 0.15, and 0.12, and 0.09. The aspect ratios were 6, 9, 12 and infinity. Results of force and pitching moment measurements over the angle of attack range for all combinations of Reynolds numbers, thickness, and aspect ratios, and the effects of boundary layer tripping are presented.

23736 (STEV-VIND—83-32) Power and revolution counter for a synchronous wind generator with rectifiers designed for battery charging. Eriksson, R.; Briozzo, C. (Statens Energiverk, Stockholm (Sweden)). Sep 1983. 22p. (In Swedish). NTIS (US Sales Only), PC A02. File Number DE85751436.

A system for continous measurement of revolution frequency and power at the SVIAB 065 wind turbine has been designed.

23737 (STEV-VIND—83-33) Evaluation of the SVIAB 065 wind energy conversion system for battery charging. Briozzo, C.; Tsiolis, S. (Statens Energiverk, Stockholm (Sweden)). Sep 1983. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85751435.

This report contains the final evaluation of the SVIAB SWECS 065, a wind energy conversion system for battery charging. The measurements were performed at the Test Station of SWECS in Fiskebaeck, Goeteborg, build and operated by the Chalmers University of Technology. The 065 is a horizontal axis, upwind, three bladed WECS with a low speed Assar generator, that is, a self-excited synchronous generator without slip rings. A three phase rectifier provides the DC voltage for battery charging. The power is controlled by a pendular vane which, for wind speeds higher than 10 m/s makes the turbine to turn around the vertical axis out of the wind direction. The performance evaluation is based on about 20,000 samples of wind speed, power, speed and wind direction collected under February-May 1983. The system test comprises the measurement of the transients and the runaway speed when disconnecting the generator from the load, and observations of the behaviour of the pendular vane, both in normal and runaway operation. The results show a maximum power output of 500 W at 12.5 m/s, a cut in speed of about 3 m/s and a total efficiency of 21 to 25 percent between 5 and 10 m/s, which may be considered as satisfactory. Since the Assar generator has an efficiency of 56 percent max, the conclusion is that the Csub(p) is very high. The runaway speed doesn't exceed 1000 rpm in any case. The pendular vane works satisfactorily. The angle between the wind direction and the turbine shaft depends on the wind speed, not on the load. The unit was in continuous operation during the period December 1982-September 1983. No serious problems were detected during this time.

23738 (STEV-VIND—84-31) Autonomous wind-diesel system without energy storage. Holmblad, L. (Statens Energiverk, Stockholm (Sweden)). Aug 1984. 18p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751440.

A laboratory model of an autonomous wind-diesel system without energy storage has been investigated at the Department of Electrical Machines and Power Electronics, Chalmers University of Technology, Goeteborg. The model consists of a simulated windmill with an induction generator, a simulated diesel engine with a synchronous generator, a dump load and a simple control unit. The rated power of the wind generator is 1.5 kW and the rated power of the diesel generator is 1.0 kW. The results show that the frequency variation is +-5 percent and the voltage variation is between +5 percent and -10 percent. The system is sensitive to fluctuations. The variations in frequency and voltage are about twice as large as for a standard diesel generator set. The investigation show that a thoroughly considered strategy for stop/start of the diesel engine is important to prevent the diesel from starting too often or runing for too long periods.

23739 (STEV-VIND—84-32) 25 kW autonomous wind-diesel system with transistor convertors and accumulator storage. A progress report. Holmblad, L.; Linders, J. (Statens Energiverk, Stockholm (Sweden)). Oct 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85751439.

This paper describes an autonomous wind-diesel system with energy storage under development at The Department of Electrical Machines and Power Electronics, Chalmers University of Technology. This system is the base for a wind-diesel study in collaboration with Risoe National Laboratories, Denmark. The components of the system are described: a windmill with an asynchronous generator, a power regulating unit, an accumulator, two convertors, a

diesel engine with a synchronous generator and a computer control system. The control strategy is described: the frequency and the voltage control, the accumulator control, the diesel start/stop strategy and the wind power optimation. Finally the present situation is accounted for.

23740 **(STEV-VIND—84-36) Main report from the full scale tests at Maglarp.** Ekbom, P.O. (Statens Energiverk, Stockholm (Sweden)). Oct 1984. 149p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE85751459.

Operational experiences from the test period September 1983 to August 1984 at the 2 MW wind power plant are reported. The plant has been in operation 2428h during the period 830922-840625, with a mean power output of 1.57 MW at a mean wind speed of 8.3 m/s.

23741 **(TVA/OP/EDT—84/41-Vol.1) TVA/DOE analysis of the operation of an electric power system with and without wind generation. Volume I. Description of the 1978 TVA power system. Final report.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). Mar 1985. Contract AI01-79ET23077. 251p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85009036.

An analytical investigation was conducted on the impact of intermittent wind generation on the operations of the TVA power system. The investigation was divided into three phases. The first phase was the documentation of the 1978 TVA power system, which was selected as the base case. The second phase dealt with the hypothetical reconfiguration of the TVA transmission system to accommodate up to 8480 MW of wind-generating capacity. The third phase was the simulation of the daily operations of the TVA system with wind generation. The major conclusions of the second phase were the control and protection schemes for wind energy conversion systems (WECS). Transient stability studies showed that WECS units could be integrated into the TVA power system without compromising the system integrity. Results of the simulations in the third phase showed that, if wind generation is treated as a controlled negative load with the assumed short-term wind generation variability, the impacts on load frequency control may be significant enough to warrant limiting the penetration levels of wind-generating capacity to about 15% of the total power system generating capacity.

20 ELECTRIC POWER ENGINEERING

23742 **(DOE/RA/50276—T2) Power system dispatcher modeling in the emergency state. Second annual report.** Alexandridis, M.G.; Entin, E.E.; Kleinman, D.L.; Pattipati, K.R. (ALPHATECH, Inc., Burlington, MA (USA)). Feb 1983. Contract AC01-80RA50276. 62p. (TR—154). NTIS, PC A04/MF A01; GPO Dep. File Number DE85009544.

A behavioral model of a power system dispatcher's cognitive activities during an emergency event is formulated. An emergency event is the loss of a generator or the loss of a transmission line. The dispatcher responds to power system emergency alarms by rescheduling generation (fossil, hydroelectric, or internal combustion units), shedding load, or reducing voltage to restore the power system to a secure rate. The dispatcher's activities are conceptualized as a cascade coupling of: (1) an information processing procedure, (2) a decisionmaking procedure, and (3) a forecasting procedure. Normative-descriptive mathematical representations for each procedure are developed. At the root of these representations is the dispatcher's internal (mental) mode of the power system's dynamics: a simplification of the actual dynamics. Human imperfect display monitoring, short-term memory capacity, and serial processing are explicitly encoded. Results of an application of the model to two hypothetical emergency scenarios in the New England Test System are discussed.

23743 **(DOE/RA/50276—T3) Power system dispatcher modeling in the emergency state. First annual report.** Pattipati, K.R.; Entin, E.E.; Kleinman, D.L.; Wohl, J.G.; Gully, S.W. (ALPHATECH, Inc., Burlington, MA (USA)). [1982]. Contract AC01-80RA50276. 141p. (TR—126). NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85009347.

The results of an ongoing analytic and interview approach to modeling the behavior of a power system dispatcher under emergency situations is described. During power system emergencies, the dispatcher is faced with a task environment characterized by limited time for decision, high stakes, informational uncertainty, and consequence of action uncertainty. The field interview provided valuable insights into a human's mental of a power system. Also obtained was the dispatcher's information sources, action priorities, planning horizon, and salient common features of problem solving/decisionmaking behavior for various types of power system disturbances. These results, along with the relevant steady-state power system truth models, were incorporated in an analytic framework based on behavioral decision theory, artificial intelligence and cognitive science to produce a normative-descriptive model of dispatcher behavior. The model predictions of dispatcher performance and model validation by interview process will form the next phase of the ongoing effort.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 23407, 23923, 23983

23744 (CONF-830669—, pp 132-145) **How do climate and forecasting affect electricity consumption?.** Reiter, E.R. (Colorado State Univ., Fort Collins). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

Peak electricity consumption is related to meteorological parameters, such as present and past temperatures. Thus, climate anomalies, such as prolonged hot periods during summer and cold periods during winter, can cause excessive demands on energy. As such demands are anticipated, older and usually less efficient generators will have to be brought on line. With adequate weather forecasts over periods that at least equal the longest start-up time among all generators, the system's operating schedule and costs can be optimized with a simple modelling procedure. The weather-dependent energy use in individual buildings varies greatly from case to case. From model results it seems that those buildings that are most sensitive to ambient weather and climate variations also are the most energy efficient. Model applications also allow accurate assessments of the efficiency of energy conservation measures.

23745 **(DOE/METC—85/2007) Adherence of ash particles from the combustion of micronized coal.** Anderson, R.J.; Romanowski, C.J.; France, J.E. (USDOE Morgantown Energy Technology Center, WV). Oct 1984. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85008600.

Experimental studies have addressed the adherence of residual particles resulting from the combustion of micronized coal under conditions approximating those found in combustion gas turbine hot gas pathways and components. The objectives of the studies are to understand the basic mechanisms responsible for the formation of the deposits and to develop a data base for the sticking coefficient (the fraction of particles adhering to a surface following collisions with the surface) of ash particles as a function of various parameters related to the hot gas stream, entrained particles, and subject surface. The tests utilize an entrained reactor which has been modified by the inclusion of an exhaust acceleration nozzle. Hot gas and entrained particles exit the nozzle at velocities up to 300 m/s and impinge on a target substrate whose surface can be controlled to temperatures as high as 1,350 K. All tests have been conducted with the target normal to the centerline of the nozzle. Measured values of the sticking coefficient have ranged from about 0.01 to 0.10 and are shown to be dependent upon target temperature, combustion temperature, and gas velocity. 16 refs., 6 figs., 1 tab.

23746 (DOE/PC/40272—8) Mechanisms of fouling, slagging and corrosion by pulverized coal combustion. Hsu, L.L.; Kubarych, K.G.; Stetson, A.R.; Metcalfe, A.G. (Solar Turbines, Inc., San Diego, CA (USA)). Jun 1984. Contract AC22-81PC40272. 194p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85008002.

The objective of this program is to conduct a detailed and comprehensive study of the mechanisms of fouling, slagging and corrosion in pulverized coal combustors by employing well controlled model systems which simulate the coal combustion environment. A combustion test rig was designed, constructed and calibrated for parametric tests in which the following variables were evaluated: Non-condensing alkali (NaCl), condensing alkali (Na_2SO_4, K_2SO_4), alkali ratio (Na/K) - melting point depression, inert particles (Al_2O_3), reactive particles (SiO_2 and Fe_2O_3), ash viscosity (SiO_2, Al_2O_3, CaO, Fe_2O_3 glasses), sulfur (SOx gas, SO_4^{2-}), incomplete combustion - reducing agent (carbon), reactive surface area (SiO_2 particle size > standard SiO_2 particle size), gas stream and particle velocity, and tube material and tube temperature. Four target tube materials were employed: SiC (2000°F), Hastelloy X (1600°F), Croloy (1100°F) and SA-210 (800°F). Particulate fouling species used in the rig tests ranged from SiO_2 and Al_2O_3 to complex glasses simulating coal ash. In reviewing the wealth of information generated in the test program, a number of significant findings emerge as being most urgent to fouling/slagging: Target tube temperature, viscosity profile, fouling medium particle size and shape, reactivity of fouling medium, aerodynamic flow, dewpoint/condensation of sulfates, particle loading rate, and surface finish. Four approaches are recommended as being potentially capable of reducing fouling and slagging: Chemical control, mechanical erosion (deposit removal), aerodynamic optimization, and elimination of tube corrosion by ceramic coatings. 46 refs., 105 figs., 23 tabs.

23747 (EPRI-AP—3932) Coal-fired combustor particulate measurements. Final report. Roy, G.D. (TRW Energy Development Group, Redondo Beach, CA (USA)). Apr 1985. 72p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI85920597.

Particulate measurements were carried out in the exhaust of a 20 MW/sub t/, 6 atmospheres slagging coal combustor. A water cooled sampling probe and a particle impactor were used to characterize the combustor exhaust gases. Tests were conducted with a nominal 15% ash, 20% moisture Montana coal. The particulate carry-over was found to be approximately 5% of the original coal ash. With this combustor used as the first stage of a two stage combustion system for MHD conditions (0.80 stoichiometric ratio and 44% overall oxygen enrichment), this would correspond to a particulate loading of approximately 1600 ppM by weight. With the second stage providing typical gas turbine operating conditions (2.5 final stoichiometric ratio and air as the oxidizer), the corresponding loading would be about 300 ppM. The measurement of the particulate size distribution showed that at most, 10% by weight of the particles are larger than 10 microns in diameter. Thus, starting with a 15% ash coal, this would translate, for gas turbine applications, into a loading of the order of 30 ppM for particles larger than 10 microns in diameter. The elemental analysis of the particles indicated excellent carbon conversion (less than 0.05% carbon losses) with a slight depletion in silicon and slight enrichment in alkalis (potassium and sodium). 1 ref., 23 figs., 12 tabs.

23748 (EPRI-CS—3914) Biofouling detection monitoring devices: status assessment. Final report. Hillman, R.E.; Anson, D.; Corliss, J.M.; Vigon, B.W.; Gray, R.H.; Bomelburg, H.J. (Battelle New England Marine Research Lab., Duxbury, MA (USA); Battelle Columbus Labs., OH (USA); Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 119p. NTIS, PC A06/MF A01 - Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $13.00; GPO Dep. File Number DE85009024.

An inventory of devices to detect and monitor biofouling in power plant condenser systems was prepared. The inventory was developed through a review of manufacturers' product information brochures, a general literature review, and limited personal contact with users and manufacturers. Two macrofouling and seventeen microfouling detection devices were reviewed. A summary analysis of the principal features of each device was prepared. Macrofouling devices are generally simple devices located at or near cooling water intakes. They monitor the growth of larger organisms such as mussels, barnacles, and large seaweeds. Microfouling detectors are usually located in or near the condenser tubes. They detect and monitor the growth of slime films on the tubes. Some of the devices measure changes in heat transfer or pressure drop in the condenser tubes. Other types include condenser simulators, biofilm samplers, or devices that measure the acoustic properties of the fouling films. Most devices are still in the development stage. Of the few available for general use, the type that measures heat transfer and/or pressure drop are developed to a greater degree than the other types. Recommendations for further research into development of a biofouling detection and monitoring devices include a side-by-side field comparison of selected devices, and the continued development of an effective acoustic device.

23749 Overview of Design of Advanced Fossil Fuel Systems (DAFFS) study. Bomkamp, D.H.; Bezella, W.A.; Pietrusziewicz, J.; Smith, R.S. (Argonne National Laboratory, Argonne, IL). *Proceedings, Intersociety Energy Conversion Engineering Conference;* 2: 1234-1242(Aug 1984). (CONF-840804—).

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

The objective of the DAFFS (Design of Advanced Fossil Fuel Systems) study was to characterize the costs and performance of three advanced power generation technologies: Pulverized Coal Fired with Advanced Flue Gas Desulfurization, Pressurized Fluidized Bed, and Integrated Gasification Combined Cycle. Uniform ground rules and a 1990 state-of-the-art frame of reference were established to obtain designs incorporating reasonable and comparable extrapolations from present levels of performance. The study is intended to provide baseline reference data for future estimates of the potential benefits of component and performance development beyond the levels assumed in the study.

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REFER ALSO TO CITATION(S) 23415, 23418

23750 (CONF-830669—, pp 104-114) Summary report of the Panel on Climate and the Electric Utilities. Rotty, R.M.; Wendland, W.M. (Oak Ridge Associated Universities, TN). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

Meteorological and climatological conditions affect both the operation and planning processes of the electric utility industry. Plant siting, deciding when to start peaking load units, and steps to minimize cost of damage from an imminent ice storm are examples in which the decisions made depend at least partially on weather and climate. Meteorological data are defined as those that describe the atmosphere at a particular instant and given location, or predict its changes from the present for the next few days. Climatological data include hourly or daily observations accumulated over many years, often summarized as mean hourly, daily, or monthly values. Both meteorological and climatological data and their impacts on decision making by the electric utility industry are discussed. The question of potential benefits from improved long-range forecasts is considered.

23751 (CONF-830669—, pp 115-118) Climate information used in the electric utility industry. Geollner, J.C. (Edison Electric Institute, Washington, DC). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

Based on 1981 statistics, the electric utility industry generated more than 2 quadrillion watts of electric energy every hour to 94 million customers. Utilities use a myriad of sophisticated and analytical tools for evaluating and forecasting to ensure an adequate supply of electricity to its customers. One of these tools is climate and weather information. Four applications of climate data used by

utilities include load estimation, hydro analysis, storm prediction, and power plant plume tracking.

23752 (CONF-830669—, pp 119-131) **Weather normalization of electric load.** Ison, C.C.; Piotroski, S.A.; Mogolesko, F. (Boston Edison Co., MA). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

A multivariate weather normalization model is described that was recently developed at Boston Edison in response to the industry's increasing concern with the relationship between weather and the demand for electric energy (load). The model, which comprises 144 equations tailored to different temperature ranges, hours of the day, and day types, adjusts load according to temperature, relative humidity, sky cover, temperature-humidity index, and wind speed. Weather normalization through the use of this model has produced smoother monthly growth trends from year to year, allowing for better estimates of nonweather related load growth for each month to be obtained.

23753 (CONF-850276—) **NOsub(x) symposium, Karlsruhe 1985: International operational experience.** Rentz, O.; Issle, F.; Weibel, M. (Electric Power Development Co. Ltd., Tokyo (Japan); Karlsruhe Univ. (T.H.) (Germany, F.R.). Inst. fuer Industriebetriebslehre und Industrielle Produktion; Verein Deutscher Ingenieure (VDI) - Gesellschaft Energietechnik, Duesseldorf (Germany, F.R.)). Feb 1985. 601p. (In German and English). NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

After a review of NOsub(x) reduction measures in Japan, the USA, and Europe, Japanese power station operators and producers report their experience in the construction and operation of NOsub(x) removal systems in coal-fired power stations. The conference papers have been recorded separately.

23754 (CONF-850276—, pp A1-A42) **Review of Japanese NOsub(x) abatement technology for stationary sources.** Ando, J. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Numerous stationary sources in Japan have applied combustion modification (CM) including low-NOsub(x) burner (LNB) to reduce 20-80% of NOsub(x). Nosub(x) concentrations in flue gases form utility boilers have been lowered by CM to 150-300 ppm for coal-(dry bottom), 80-130 ppm for oil-, and 40-80 ppm for gas-firing. For further NOsub(x) abatement, about 160 plants for selective catalytic reduction (SCR) of NOsub(x) with a total capacity of 28.000 MW equivalent have been constructed to remove 60-90% of NOsub(x). For coal-fired boilers, a combination of CM, SCR, electrostatic precipitator (ESP), and wet FGD has been applied. The power generation cost by coal with the combined flue gas cleaning is less than that by oil to give a flue gas of about equal quality. SCR is much more costly than CM to remove equal amount of NOsub(x). Although SCR is cheaper than FGD in the cost per kWh, it is more costly than FGD in terms of the acid removal efficiency. SCR has started to be applied also to flue gases from combined cycle power plants firing oil or gas. Selective noncatalytic reduction or thermal DeNOsub(x) as well as in-furnace NOsub(x) reduction is in commercial use. Many wet processes for NOsub(x) or simultaneous SOsub(x) and NOsub(x) removal were tested. Some of them have been applied commercially to small plants but not to large plants. Dry simultaneous removal processes such as activated coke and electron beam processes have been tested aiming at the application to large plants. Fluidized bed combustion of coal has been tested and applied commercially to several industrial boilers reducing both SOsub(x) and NOsub(x).

23755 (CONF-850276—, pp B1-B24) **Review of U.S. NOsub(x) abatement technology.** Mobley, J.D.; Jones, G.D. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Research and development of nitrogen oxide (NOsub(x)) control techniques in the United States has included a variety of combustion related techniques as well as selective catalytic reduction (SCR) of NOsub(x) with ammonia (NH_3). Current naitonal emission standards for both utility and industrial boilers will require either low NOsub(x) burners or combustion modifications to achieve compliance. The State of California has more stringent regulations that, in some cases, require the use of SCR to achieve complience; however, there have been no commercial applications to utility boilers. Results from pilot unit testing of SCR have allowed the costs of full scale systems to be estimated. Current research is directed toward processes that remove NOsub(x) and sulfur oxides (SOsub(x)) simultaneouly.

23756 (CONF-850276—, pp C1-C33) **Regulations and their implementation for achieving the required reduction of NOsub(x) emissions from fossil-fuel power plants.** Lange, M. Feb 1985. (In German). NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

The regulations defining NOsub(x) emission standards and the methods applied to meet the requirements for reducing NOsub(x) emissions vary significantly among member states of the EC. In the Federal Republic of Germany, operators have to cope with very low NOsub(x) emission limiting standards for both existing and new installations. Plants with a heat output of more than 300 MW are to be equipped with appropriate systems for NOsub(x) control. Obligatory retrofitting of existing installations is expected to be completed around the year 1990. For plants with a heat output between 50 and 300 MW, combustion modifications are required. Provisions in Austria also require secondary measures for NOsub(x) emission control from coal-fired power plants. The authorities in Switzerland issued a draft code, making NOsub(x) emission control systems obligatory for coal-fired furnaces (>100 MWsub(th)). Emission standards valid in the Netherlands, in Denmark and Sweden are based on the application of combustion-related techniques.

23757 (CONF-850276—, pp D1-D44) **Review of NOsub(x) reduction measures in Europe.** Necker, P. Feb 1985. (In German). NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Of the European countries, West Germany has the most rigid laws on air pollution abatement and thus (together with Austria) the most advanced NOsub(x) reduction technology. With particular emphasis on industrial-scale hard coal and brown coal furnaces, the author describes the state of the art of primary and secondary NOsub(x) reduction measures in old and new plants. He also outlines some trends of development. In the field of secondary measures, new technologies developed in West Germany are mentioned apart from the well-tried Japanese SCR process. In view of the high technological level reached so far, industrial-scale application of secondary NOsub(x) reduction measures by 1987/88 can be expected. Primary measures in furnaces with reduced NOsub(x) emissions are already feasible.

23758 (CONF-850276—, pp E1-E30) **Past experience and the present NOsub(x) emission level of coal firing boiler owned by EPDC.** Sato, S. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

As the combustion modification technology, the two-stage combustion equipment, low NOsub(x) burner, gas mixing method, etc. have adopted, thereby NOsub(x) concentration has successfully been reduced to 150 proportional 300 ppm (310 proportional 620 mg as NO_2/Nm^3) which is equivalent to 1/2 proportional 1/4 of the concentration in the case where no improvement measures were adopted. In the case of units where emission control requirements are severer than the level cited above, Selective Catalytic Reduction (SCR) denitrification system has been installed, thereby NOsub(x) concentration has been reduced to 60 proportional 70 ppm (120 proportional 140 mg as NO_2/Nm^3).

23759 (CONF-850276—, pp F1-F21) **Past experience of the pilot plant of SCR system for coal firing unit by EPDC.** Mouri, K. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

As a result of these R and D programs, EPDC got more than 80% NOsub(x) removal efficiency, less than 5 ppm of leakage ammonia and less than 1% SO_2 to SO_3 conversion rate on DeNOsub(x) catalyst for coal fired boiler, and establishment of countermeasure on air preheater plugging trouble and on enrichment of ammonia in waste water from wet-Flue Gas Desulphu.ization (FGD). Next stage, EPDC conducted full scale demonstration test program at EPDC's Takehara Power Station unit No. 1 (250 MW coal fired). The next stage, EPDC constructed full scale commercial SCR equipment at the Takehara Thermal Station unit No. 3 (700 MW coal fired) in 1983. This report describes the results of R and D programs conducted by EPDC and joint researchers concerning DeNOsub(x) catalysts, air preheater problem and denitration of ammonia in waste water from FGD for dry bottom type of coal fired boilers.

23760 (CONF-850276—, pp G1-G22) **Demonstration test results of SCR system of Takehara No. 1, 250MW coal firing unit.** Honda, K. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Before the application of SCR to the commercial unit, EPDC has installed the demonstration test unit of SCR treating total volume of flue gas (800.000 m^3/H) with the De-Nosub(x) efficiency of 80% to Takehara No. 1 unit (coal-firing plant with power capacity of 250 MW) under the governmental ensured. For this demonstration, the Low Dust SCR system was adopted, which was considered to be most suitable for this purpose. The construction of this system began in 1978, and one year since 1981 the test operation was performed. After the termination of the test operation, this demonstration test equipment is still in operation as commercial SCR plant. In this article the outline performance and operation result are introduced.

23761 (CONF-850276—, pp H1-H24) **Operation results of DeNOsub(x) system (SCR) for unit No. 3 (700MW) at Takehara thermal power station, Japan.** Watanabe, J. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Unit No. 3 (700 MW) of Takehara thermal power station was constructed as a plant for imported coal firing and put into commercial operation in March, 1983. This unit is the biggest of all coal firing units in Japan at present. Strict local environmental regulations necessitated utilization of a total flue gas treatment system in this unit consisting of an elctrostatic precipitator, and DeNOsub(x) and DeSOsub(x) systems with the newest technology. Especially, a SCR system was adopted as NOsub(x) abatement equipment. Unit No. 3 has been in operation for approximately 1.5 years with no experience of trouble. The outline of SCR system planning and its operation results are presented.

23762 (CONF-850276—, pp I1-I51) **Future forecast of the research and evaluation on the integrated flue gas treatment system.** Nakabayashi, Y. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Review on flue gas treatment systems for NOsub(x), SO_2 and dusts including cost comparisons: 1. SCR (Selective Catalytic Reduction); 2. non-catalytic NOsub(x) reduction processes; 3. activated charcoal process; 4. wet $Mg(OH)_2$ process; 5. electron beam process; 6. Walther process; 7. fluidized bed combustion.

23763 (CONF-850276—, pp K1-K40) **Ljungstroem heat exchangers in plants having a flue gas denitration (DeNOsub(x)) system.** Omote, N. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Heat exchanger installed after a flue gas denitration system (SCR) can suffer pluggage and corrosion on its heating surface depending on the concentrations of NH_3, SO_3 and H_2O which are present in incoming gas. Because these substances combine together to form ammonium bisulfate in a certain temperature range which exists in the heat exchanger. To protect Ljungstroem regenerative heat exchanger against the said impediments - whether it is used as an air preheater for the boiler or as a gas-gas heater for tail-end deNOsub(x) system, remedial measures must be taken in two areas: i) to hold low the amount of NH_3 which is carried over from the deNOsub(x) process and ii) to minimize deposits of ammonium bisulfate by providing appropriate heating elements and effective soot blowings.

23764 (CONF-850276—, pp L1-L39) **Babcock Hitachi NOsub(x) abatement technology.** Kuroda, H.; Masai, T. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

In response to the recent increasing needs for clean environment, we have developed two kinds of NOsub(x) abatement technology. One is combustion technology with a low NOsub(x) burner and the other is catalytic DeNOsub(x) technology. We introduce briefly the combustion technology and state mainly the catalytic DeNOsub(x) technology. The catalytic DeNOsub(x) technology in this paper means the SCR which has already been developed and commercialized in Japan and 20 DeNOsub(x) plants for coal fired utility boilers are in operation as of Dec. 1984. We introduce in this paper the development of the catalyst, considerations for coal fired boilers, layout of reactors, three systems with DeNOsub(x) and DeNOsub(x) plants in actual operation.

23765 (CONF-850276—, pp M1-M45) **NOsub(x) abatement systems developed by Hitachi Zosen.** Nagai, K.; Tanaka, S. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Characteristics and performances of the honeycomb structure catalyst developed for application to coal-fired flue gas, and the experiences of demonstration plants are presented. In addition, SCR system applied to combined cycle gas turbine power plant using honeycomb catalyst is included for reference.

23766 (CONF-850276—, pp N1-N50) **NOsub(x) abatement technologies in IHI.** Ishimoto, R.; Miyamae, S. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

For NOsub(x) abatement, at first primary technologies such as low NOsub(x) burners, two-stage firing with over-firing air ports, flue gas mixing into combustion air, and combinations of these measures were retrofitted to existing utility boilers. The application of these primary technologies progresses smoothly, and extremely low NOsub(x) emission levels have been achieved already. Parallel with the progress of primary technologies, IHI has devoted itself to the R and D of post-combustion NOsub(x) abatement technologies, and among these IHI found that the Selective Catalytic Reduction (SCR) system was the best solution. IHI's catalyst developed from ferrous types to Ti-V types which proved to have higher efficiency and much longer life. More than twenty SCR units for large capacity utility boilers (up to 700 MW) with oil, gas and coal firing are now in satisfactory operation.

23767 (CONF-850276—, pp O1-O16) **Dry selective catalytic NOsub(x) removal system.** Iwata, K.; Nishimoto, Y.; Muraishi, K. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Dry selective catalytic NOsub(x) removal system (SCR) is described generally.

23768 (CONF-850276—, pp P1-P50) **Development on low NOsub(x) combustion technology.** Sakai, M.; Fujima, Y.; Namiki, T.; Okada, M. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

A series of low NOsub(x) composition technologies has been developed and has already been in commercial use to the customer's satisfaction. The technology consists of low NOsub(x) burners and NOsub(x) reduction in furnaces. These technologies have been brought up from technical research to examine any phenomena in the combustion, which is favorable to suppress NOsub(x) formation and to decompose NOsub(x). So far as the low NOsub(x) burner is concerned, the condition of lower NOsub(x) at higher air to fuel ratio in combustion of fuel-air mixture is fully utilized.

23769 (CONF-850276—, pp R1-R45) **Kawasaki's technology on NOsub(x) abatement.** Yanai, M. Feb 1985. NTIS (US Sales Only), PC A99/MF A01. File Number DE85770255.

From NO/sub x/ symposium - international operational experience; Karlsruhe, F.R. Germany (21 Feb 1985).

Technical burden of combustion modification in coal fired boiler application is to suppress possible increment of unburned carbon as well as to suppress NOsub(x) emission. Sunagawa Unit 4 of Hokkaido EPCO. adopting our combustion modification technology continues reliable operation from startup and proves our technology. Nowadays we are making effort for further advance of combustion modification using KVC. Regarding SCR, catalyst improvement forming SOsub(x) resistant TiO_2 base material into dust free configuration has made coal fired boiler application possible. Takehara Unit 1. SCR of EPDC continues over 3 years operation without catalyst replacement. It is believed that the combination of SCR and combustion modification is an essentially suitable way to NOsub(x) abatement in coal fired boiler and is applicable with some modification even if coal brand and/or boiler type may be varied.

23770 (FES—75-79-Vol.2) **Supplementary appendix to fiscal year 1976 program. Final environmental statement. Volume II.** (Bonneville Power Administration, Portland, OR (USA)). [16 Sep 1975]. 443p. NTIS, PC A19. File Number DE85010087.

This volume contains letters received on locating the power transmission lines. (MOW)

2003 Power Transmission And Distribution

23771 (DOE/CE/76245—1) **Seventh annual Program Information Notice .** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Energy Systems Research). Oct 1984. Contract AC01-84CE76245. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85000210.

This seventh edition of the Program Information Notice (PIN) has been revised and expanded to provide readers with a more comprehensive view of the Electric Energy Systems Division (EES) Program. The basic purpose of the notice is to provide information on EES technical progress in research and development specifically concerned with the nation's electric energy system. The introduction includes a brief history of EES and its program objectives and strategies. The organization of EES is discussed and related to the technical research areas. As before, the notice contains a synopsis of the major areas, subsequent summaries of the research projects under each area, and published reports resulting from past efforts.

21 NUCLEAR POWER PLANTS

23772 (DOE/ER/10275—1C, pp 1, Paper 34) **Computerization of the Brayton cycle.** Perez, C.P. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The computer code "BRAYTON" has two functions. The first is as an educational device which interacts with the user by asking him questions as to what parameters are to be inputted. Therefore, a beginner will not have to spend useless time in doing the calculations required by the Brayton cycle to get to the desired end. The second is as a research tool. One can easily optimize the pressure ratio, gaseous material utilized, etc. by simply imputting the parameters and having the code do all the calculations.

23773 (DOE/ER/10275—1C, pp 1, Paper 37) **Computerization of thermodynamic steam cycles.** Perez, C.P. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The computer code "THERMO", has two uses. The first is as an educational device. All the user has to do is log into the code and THERMO will do the rest. It will ask the user which process it wants from Simple Rankine, Regenerative, Reheat or Electronic Steam Tables. It will then ask the user for the input parameters, upon which it will return the answer after doing all the calculations. The second use is as a research tool. Quick results can be obtained using various efficiencies for the components in the cycle and pressures, plus temperatures throughout the cycle. Overall, THERMO rids the user of doing busy work such as looking up steam tables, interpolation, calculations from component one to component two, from component two to component three, etc.

23774 (DOE/NE—0048/8) **UPDATE: Nuclear Power Program information and data, July-September 1984.** (USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Office of Converter Reactor Deployment). Feb 1985. 108p. (PB—84-911503). NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85010433.

UPDATE is published by the Office of Converter Reactor Deployment, Office of Nuclear Energy, to provide a quick reference source on the current status of nuclear powerplant construction and operation in the United States and for information on the fuel cycle, economics, and performance of nuclear generating units. Similar information on other means of electric generation as related to nuclear power is included when appropriate. The subject matter of the reports and analyses presented in UPDATE will vary from issue to issue, reflecting changes in foci of interest and new developments in the field of commercial nuclear power generation. UPDATE is intended to provide a timely source of current statistics, results of analyses, and programmatic information proceeding from the activities of the Office of Nuclear Energy and other components of the Department of Energy, as well as condensations of topical articles from other sources of interest to the nuclear community. It also facilitates quick responses to requests for data and information of the type often solicited from this office.

23775 (PNL-SA—12562) **Overview of nonchemical decontamination techniques.** Allen, R.P. (Pacific Northwest Labs., Richland, WA (USA)). Sep 1984. Contract AC06-76RL01830. 12p. (CONF-840956—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010054.

From Executive conference on the decontamination of power plant reactors--costs, benefits, and consequences; Springfield, MA, USA (16 Sep 1984).

The decontamination techniques summarized in this paper represent a variety of surface cleaning methods developed or adapted for component and facility-type decontamination applications ranging from small hand tools to reactor cavities and other large surface areas. The major conclusion is that decontamination is a complex, demanding technical discipline. It requires knowledgeable, experienced and well-trained personnel to select proper techniques and combinations of techniques for the varied plant applications and to realize their full performance potential. Unfortunately, decontamination in many plants has the lowest priority of almost any activity. Operators are unskilled and turnover is so frequent that expensive decontamination capabilities remain unused while decontamination operations revert to the most rudimentary type of hand scrubbing and water spray cleaning.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 23531, 23812, 23816, 23817, 23838, 23840, 23843, 23845, 23847, 23852, 23857, 23866, 23869

23776 (DOE/ER/10275—1C, pp 1, Paper 28) **Autoregressive time series models and Pade approximants - application to BWR stability.** March-Leuba, J. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Autoregressive (AR) time series models have been used for a wide range of applications. This paper shows the relationship between these models and the Pade approximants (PA) and develops a methodology to obtain a pole-zero representation of the data in the frequency domain from the empirical AR parameters. The methodology has been applied to generated data with known structure and the poles and zeroes have been obtained sucessfully. The method has also been applied to neutron noise data from an operating boiling water reactor to determine the position of the least stable pole, and thus to quantify the stability of the reactor.

23777 (DOE/ER/10275—1C, pp 1, Paper 31) **Critical power ratio calculations in a BWR using Monte-Carlo methods.** Perez, C.P. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The critical power ratio (CPR = CP/OP) is found by determining the critical power and the operating power for each rod in each assembly. The probability of each individual rod being in boiling transition is then determined. The summation of all the probabilities for boiling transition for all the rods is found, and then from this one gets the total number of rods in boiling transition at any given point in time. This value is then compared with the value stated by federal regulations as being safe.

23778 (DOE/ER/10275—1C, pp 1, Paper 48) **Decay heat calculations for light water reactors.** Harrell, J.R. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Of the various problems associated with the shipping and storage of light water reactor spent fuel, the decay heat emitted from this fuel has become increasingly important. Until recently, several different methods have been used to make decay heat calculations. Answers from these methods have much too often varied over large ranges for the same situations. Because of their critical role in the design of spent fuel shipping casks and storage facilities, these calculations must be made by a uniform method with minimal error. Present trends are now directed toward widespread usage of the American National Standard ANSI/ANS-5.1-1979 for Decay Heat Power in Light Water Reactors. Computer codes have now been designed to generate the numbers from the equations in this standard.

23779 (DOE/ER/10275—1C, pp 1, Paper 61) **Microhardness as a measure of embrittlement of pressure vessel steels.** Meaoe, T.B. (Virginia Univ., Charlottesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The exposure of reactor pressure vessel steels to fast neutrons is known to result in reduced ductility and increased possibility of brittle failure. Initial research at the University of Virginia and previous measurements indicate that the microhardness test can be used as a supplemental nondestructive measurement of embrittlement. Increases in microhardness with irradiation correlate with shifts in the ductile to brittle transition temperature. It appears that the microhardness test can provide a direct measurement of the actual transition temperature, irradiation induced shifts in transition temperature and in uppershelf fracture energy. Thus, the microhardness test may provide a valid method for supplying the material property information required for safety analyses to prevent the premature shutdown of some operating nuclear power plants.

23780 (EPRI-NP—3832) **Field test and evaluation of electropolishing and preoxidation processes for Type-316 stainless steel nuclear-grade piping. Final report.** Spalaris, C.N.; Wang, M.J. (Quadrex Corp., Campbell, CA (USA); General Electric Co., San Jose, CA (USA). Nuclear Energy Engineering Div.). Mar 1985. 154p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $16.00. File Number TI85920566.

Pretreatment of BWR replacement recirculation piping by electropolishing or preoxidation greatly reduces radiation buildup. Now, examination of full-scale samples pretreated by both processes shows that neither treatment degrades the integrity of the pipe steel or lessens its resistance to stress corrosion cracking.

23781 (GEAP—25163-10) **Demonstration of fuel resistant to pellet-cladding interaction. Phase 2 final report.** Rowland, T.C. (comp.). (General Electric Co., San Jose, CA (USA). Nuclear Fuel Engineering Dept.). Nov 1984. Contract AC02-77ET34001. 378p. NTIS (US Sales Only), PC A17/MF A01; 1; GPO Dep. File Number DE85010156.

The program was begun in 1977 and has resulted in the selection of the Zr-barrier fuel type for the large-scale demonstration; 144 Zr-barrier fuel bundles are in the demonstration in the Quad Cities-2 commercial boiling water reactor. The demonstration involves irradiation of these bundles and a planned withdrawal of control blades to provide a drastic power ramp to demonstrate the ability of this fuel to resist PCI under actual service conditions. The demonstration per se was supported by an extensive program of fuel rod ramp tests in a test reactor, and other in-reactor tests which were designed to evaluate the behavior of the advanced fuel in off-normal and in potential accident situations. All of the in-reactor work has been supported by laboratory testing including simulations of PCI, loss-of-coolant accident, and operation after water (steam) ingress. Mechanical and physical characterization of the barrier cladding has also been performed in un-irradiated and irradiated conditions. The PCI-resistance of Zr-barrier fuel was shown clearly to be superior to that with conventional nonbarrier Zircaloy-cladding, and no impediments to the commercial implementation of this fuel type were discovered.

23782 (PNL-SA—13000) **Advanced ultrasonic imaging of piping in Dresden and Vermont Yankee reactors.** Doctor, S.R.; Hall, T.E.; Crawford, S.L. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 7p. (CONF-850809—43). NTIS, PC A02/MF A01. File Number TI85010049.

From 8. international conference on structural mechanics in reactor technology; Brussels, Belgium (19 Aug 1985).

Pacific Northwest Laboratory (PNL) has been developing the synthetic aperture focusing technique for ultrasonic testing (SAFT-UT) for the US Nuclear Regulatory Commission (NRC). Objectives are to make a real-time field system for performing all required inservice inpsections on nuclear power plants. The NRC funded the laboratory phase of the work at the University of Michigan. The PNL role is to transfer the technology to the field. This paper reports on the experience gained during 1984 involving the inspection of two boiling water reactor (BWR) plants in the United States. These field trials were very successful and demonstrated the advantages of using a flexible, high resolution imaging system to aid in detecting and interpreting ultrasonic reflectors.

23783 (RISLEY-Trans—4539) **Maintenance in the conventional plant section of the Beznau and Muehleberg Nuclear Power Stations.** Iten, W.; Muralt, R.; Walz, E. Translated from *VGB Kraftwerkstechnik ;* **61**: No. 8, 653-656(Aug 1981). 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901143. DE85901143

In situation-oriented (operational) strategy, repairs after the occurrence of breakdowns or damage take place by means of individual measures adapted to the situation. With preventive strategy repairs are made on a scheduled basis at fixed intervals and on the

basis of inspections, measurements and observations. The object is to determine changes in the actual state of the plant at an early stage. Preventive maintenance means more expenditure with regard to staff, materials and time, which results in costs and, if the scheduled refuelling time is exceeded, in non-availability, although it makes a considerable contribution to the avoidance of unscheduled shutdowns. In recent years there has been a clear shift in the direction of preventive maintenance at Beznau and Muehleberg. Nowadays 90 to 95% of all components are maintained in this way. According to the "bathtub curve" theory both plants are now beyond the teething trouble period and into the random failure phase. In this phase the failure rate is low and defects tend to occur randomly. This period has been extended as long as possible by means of reasonable preventive maintenance adapted to the conditions with, to a certain extent, increased intervals between inspections.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 23530, 23531, 23550, 23778, 23779, 23783, 23800, 23812, 23817, 23818, 23838, 23840, 23841, 23842, 23844, 23845, 23847, 23850, 23853, 23855, 23856, 23858, 23866, 23868, 23869

23784 (DOE/ER/10275—1C, pp 1, Paper 33) **Radiant heat transfer between the lateral surface of a cylinder and its ends.** Garcia, J. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Two problems have recently developed which required the solution of a heat transfer problem that includes radient heat transfer from a cylinder to the environment at the end of the cylinder. The first situation occurs during the casting of lead into a spent fuel shipping cask where the shells are preheated. It is necessary to predict the temperature distribution of the shell prior to the lead pour to assure that there will be no premature freezing of the lead as it contacts the shell. The second condition is in the evaluation of the heat transfer within a tube of a steam generator where the water level has dropped below the tube sheet and the tube is essentially empty. Both require the simultaneous evaluation of conduction, convection and radiation. The methods for evaluating the heat transfer by conduction and convection have been reported in the literature so this paper will deal only with the evaluation of the view factor for radiant heat transfer from a small section of the wall to the end of the cylinder.

23785 (DOE/ER/10275—1C, pp 1, Paper 35) **Optimization of the Nuclear Steam Supply System.** Ashe, K. (North Carolina State Univ., Raleigh). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The problem addressed in this study was the minimization of the cost of the Nuclear Steam Supply System for the lifetime of a Pressurized Water Reactor Nuclear Power Plant. Three major constraints which affected the problem were: (1) maximum fuel discharge burnup limit of 45,000 MWd/MTU; (2) maximum hot leg temperature of 635°F; and (3) a 15% increased margin in critical heat flux. In addition to these constraints, all safety levels of the new design had to equal or exceed those of the reference plant, the McGuire Nuclear Station of Duke Power Company. An analysis of the plant resulted in a set of interrelated equations with corresponding constraints which described the components of the NSSS, operating parameters, and system costs. These relationships were used in a linear programming code to determine the optimum system. The results of the study indicate that the Fuel Cycle Costs are the driving force behind the minimization of costs. The results also indicate that the Fuel Cycle Costs are reduced with a reduction in core size. Therefore, the smallest core was the most economical.

23786 (DOE/ER/10275—1C, pp 1, Paper 38) **Theoretical characterization of a dual purpose gamma thermometer for use in a pressurized water reactor.** Johnson, J.O. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

A computational study was performed to further investigate the potential of a modified gamma thermometer as a monitor of both the localized power level and the adequacy of core cooling for a Pressurized Water Reactor. The basic gamma thermometer has been proposed as an instrument for measuring the local heat generation rate within a reactor core. More specifically, the gamma thermometer can be viewed as a means for measuring the localized (e.g. within a particular assembly) power level. Thus, the GT can be envisioned as providing the localized data that defines the overall power distribution within the core - which can be summed to yield the global power level of the reactor. The results of this study reaffirm the feasibility of utilizing the GT as a dual-function (power level and adequate core cooling capacity) measurement device, with each function accomplished virtually independent of the other. The study also indicates that there is a thermal-hydraulic regime for which the GT would no longer give easily interpretable signals. However, the pursuit of the GT as a viable nuclear instrument is still encouraged.

23787 (DOE/ER/10275—1C, pp 1, Paper 55) **Neutron fluence and NDTT calculations for a typical PWR reactor vessel.** Baker, S. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

In this paper the mechanisms of neutron damage in metals will be discussed briefly. In irradiated metals the nil ductility transition temperature (NDTT) is shifted to a higher value. The NDTT is the temperature at which a metal's properties begin to change from ductile to brittle. This shifting of a pressure vessel's NDTT could become a problem during certain accidents. A study has been done for a steam line break at the Calvert Cliffs site. The study analyzed the possible effects of this accident on the vessel integrity. By using ANISN, a one dimensional transport code, the fluences in the vessel of a typical PWR will be calculated. The nill ductility temperatures, which depend on the vessel fluences, will then be calculated. These results will be compared to the Calvert Cliffs study. The agreements and disagreements between the expensive study performed by BG & E and the ANISN calculations will then be looked at. This paper will also discuss briefly the alternatives the correcting the neutron damage in the reactor vessel so that vessel integrity will be maintained during such accidents.

23788 (DOE/ER/10275—1C, pp 1, Paper 59) **Neutron damage in metals and the effects it has on reactor pressure vessel integrity.** Baker, S. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

In this paper the mechanisms of neutron damage will be discussed. In irradiated metals the nil ductility transition temperature (NDTT) is shifted to a higher value. The NDTT is the temperature at which a metal's properties will change from ductile to brittle. This shifting of a pressure vessel's NDTT could become a problem during certain accidents. A study has been done for a steam line break at the Calvert Cliffs site. The study analyzed the neutron damage in the vessel and the effects the neutron may have on the vessel integrity during such an accident. The results of the Calvert Cliffs' analysis will be presented. This paper will also discuss alternative procedures to correct the neutron damage in the reactor vessel so that the vessel integrity will be maintained during a main steam line break.

23789 **(FRP—82/6) COD and J integral toughness testing of medium strength steel as a preliminary for J integral testing of SA 533 B steel.** Dahlmann, D.E.; Tait, R.B.; Garrett, G.G. (University of the Witwatersrand, Johannesburg (South Africa). Dept. of Metallurgy). Mar 1982. 62p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700883.

This report is a continuation of the initial development work towards the single specimen J integral determination for Koeberg pressure vessel steel and aims to help clarify the reproducibility and sensitivity of firstly the multiple specimen COD technique and sec-

ondly the multiple specimen J integral techniques using a medium strenght steel. The objective of this present study was to consolidate work already done which effectively measured initiation COD in Roqtuff material, by repeating COD tests and concomitantly estimating the corresponding J integral values.

23790 **(FRP—82/7) Progress report on the development of a system for studying fatigue crack growth in SA533B R.P.V. steel in representative aqueous environments.** Welihocky, A.; Tait, R.B. (University of the Witwatersrand, Johannesburg (South Africa). Dept. of Metallurgy). Mar 1982. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700884.

To ensure the safe operation of the Koeberg Nuclear Power Station, the Licensing Branch of the Atomic Energy Corporation instigated a comprehensive programme of inspection and monitoring. One programme is particularly concerned with the independent evaluation of the structural integrity of the reactor pressure vessels in an attempt to characterise crack behaviour in the actual reactor pressure vessel steel in use at Koeberg. The short term objectives of this project are to establish a sensitive and reliable crack growth monitoring method utilising the potential drop technique and ultimately computer controlled tests will be conducted in a simulated PWR environment. The long term aim is to characterise crack propagation in realistic PWR environments. This report describes the experimental programme and equipment that have been developed to reach the short term goals.

23791 **(PNL-SA—13015) 1984 NRC Branch annual report: Steam Generator Group Project.** Clark, R.A.; Bickford, R.L.; Birks, A.S.; Clark, R.L.; Doctor, P.G.; Ferris, R.H.; Fetrow, L.K.; Reece, W.D.; Schwenk, E.B.; Spanner, G.E. (Pacific Northwest Labs., Richland, WA (USA)). Feb 1985. Contract AC06-76RL01830. 32p. NTIS, PC A03/MF A01 - GPO. File Number TI85009435.

Program objectives are to develop validated models, based on experimental data, for prediction of margins-to-failure under burst and collapse pressures of steam generator tubing found to be service-degraded by eddy current inservice inspection. This required the research contractor, Pacific Northwest Laboratory, to obtain, house and prepare an out-of-service degraded steam generator for a confirmatory research program. This research includes: (1) validation of current and developmental nondestructive examination techniques; (2) optimization of inservice inspection procedures, sampling plan and inspection period; (3) validation of tube integrity predictive models; (4) validation of stress corrosion cracking predictive models; (5) development/optimization of tube plugging criteria; and (6) evaluation of proposed chemical cleaning and decontamination processes/procedures with respect to near-term integrity and long-term effects on corrosion, degradation and safety.

23792 **(TVA/PUB—85/20) ASME performance test on TVA Sequoyah Unit 1.** Deming, N.R.; Moradian, M.A.; Arnold, G.I.; Hurt, K.T. (Tennessee Valley Authority, Knoxville (USA)). 1984. 6p. NTIS, PC A02/MF A01. File Number DE85901316.

In April 1983 an ASME Performance Test was conducted on the Sequoyah 1 nuclear turbine-generator unit. Test data was collected using a mobile computer-controlled data-acquisition system. Excellent and consistent test results were achieved which showed that the unit performed better than expected. Earlier calorimetric analysis had indicated that the unit was not generating the expected electrical output. These earlier results were based on final feedwater flow measurement using permanently-installed station venturis. The ASME tests, which employed calibrated ASME throat-tap nozzles to measure feedwater flow, showed that the permanently-installed venturis had been indicating high, thereby causing the unit to be operated at less than 100% thermal power prior to the ASME test. The causes of this discrepancy are discussed in the paper. This paper includes a description of the test program and testing procedures and the performance of the major components of the heat cycle.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 23805, 23806, 24028, 24110

23793 **(DOE/ET/34034—110) Preliminary results of the Inconel 617 Optimization Program. Advanced Gas Cooled Reactor Materials Program.** Kimball, O.F. (General Electric Co., Schenectady, NY (USA). Advanced Nuclear Technology Operation). Aug 1984. 85p. NTIS, PC A05/MF A01. File Number DE85008235.

This report describes the progress in the Advanced Gas Cooled Reactor Materials program to improve the thermal stability of Inconel 617, a top candidate alloy for a Nuclear Process Heat (NPH) steam reformer. The effect of exposures at the temperatures expected for the NPH steam reformer on the room temperature toughness (impact energy and tensile ductility) and tensile strength are presented. Changes in the microstructures of the exposed specimens and the relationship between microstructural and mechanical property changes are discussed. In addition, details of the microstructural changes that are necessary for understanding the mechanisms of the thermal instability for this alloy also are included. Methods of improving the thermal stability of Inconel 617 are suggested based on the detailed microstructural changes that occur due to elevated temperature exposures. A heat treatment method for improvement of thermal stability, which has given some very encouraging preliminary results, is presented.

23794 **(JAERI-M—83-203) Studies on the core-support carbon material for VHTR, (5). Effect of long-term heat treatment on dimension, bulk density, thermal conductivity and electrical resistivity.** Matsuo, Hideto; Saito, Tamotsu. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 17p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700889.

Carbon material is one of the candidate materials for use as core-support and thermal barrier in the experimental VHTR. Stabilities of dimension and thermal conductivity at high temperature are important properties which should be intensively studied from the viewpoint of the design of the reactor core. Dimension, thermal conductivity, bulk density, and electrical resistivity were measured at room temperature after heat treatments at 1000 - 1200°C for the maximum 6350 h for the carbon material baked at 1100°C. It was clarified in the present experiment that dimension shrinked, thermal conductivity and bulk density decreased with heat treatment time after heat treatment even at 1000°C which is below the baking temperature. The experimental results are presented and discussed, and the relation between thermal conductivity and crystallite parameter was discussed as well.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

23795 **(INIS-mf—9496) Ontario Hydro 1982 annual report.** (Ontario Hydro, Toronto (Canada)). May 1983. 45p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780867.

Due to the economic recession, primary electrical energy demand for the year failed to exceed that of the previous year for the first time since 1944. Actual demand was 100.8 billion kWh, 0.8 per cent below 1981. However, annual peak demand reached 18.1 million kW on January 18, an all-time high, and 5.4 per cent over January 1981. There were 104.1 billion kWh of electricity generated during the year, nearly equally from nuclear, coal, and water power. Nuclear generating units continued their outstanding performance. Bruce-3 completed a 494-day run at continuous power. NPD Generating Station celebrated 20 years of operation. Pickering B unit 5 started up and produced its first power. At Bruce A, a remote-controlled vehicle was used to remove damaged fuel to a shielded flask, completing the job in a short time with low staff radiation exposure. Bruce B construction progressed on schedule; while at Darlington, design and construction continued at a high level, with 1700 workers on site at year-end. Actual net income was $348 million, $38 million below forecast. Coal deliveries were

13.4 million Mg (23 per cent over 1981). Nuclear fuel deliveries to generating stations were 996 Mg (3 per cent over 1981). Agreements were negotiated for the supply of 5200 Mg of uranium concentrates during 1985-93. Nuclear fuel manufacturing contracts were awarded at lower prices than previously attained. Income totalling $163 million from electricity exports to the U.S.A. reduced overall cost of providing electricity to Ontario customers by 5.1 per cent. The Residential Energy Advisory Program surveyed 16,000 homeowners wishing to improve home energy efficiency. There were 20,000 residential customers who received grants to convert from oil to electric heating. Additional consumption resulting from these conversions is estimated at 280 million kWh.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 23846, 23862, 23873

23796 (DOE/ER/10275—1C, pp 1, Paper 50) **Fast Breeder Reactors, a comparison between the LMFBR and the GCFR.** Perez, P.B. (Lowell Univ., MA). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The Liquid Metal Fast Breeder Reactor (LMFBR) has become the favorite in fast breeder reactor design. There are other types of FBRs which should be further developed in order to assure the existence of a commercial breeder in the near future in the event of unforeseen problems with the LMFBR. The LMFBR's next of kin is the Gas Cooled Fast Breeder Reactor (GCFR). This paper will examine both of these designs on a comparison-contrast basis in order to understand the advantages and disadvantages of these two advanced reactor designs.

23797 (DOE/ER/10275—1C, pp 1, Paper 51) **Neutralization of sodium contaminated components.** Vincent, G.F. (Lowell Univ., MA). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

During service some components in sodium cooled reactor systems will become chemically contaminated (Na) and may also become radiologically contaminated. Reuse or disposal of these components require that the sodium be removed in a manner which is safe to both the component (if it is to be reused) and to the personnel in the area. There are several methods of doing this. This paper will describe these methods and a system which was designed for neutralization of a decommissioned reactor vessel contaminated with sodium on its interior.

23798 (DOE/ER/10275—1C, pp 1, Paper 53) **Theoretical characterization of a dual purpose gamma thermometer for local power generation measurement in an LMFBR.** Johnson, J.O. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

A preliminary analytical and computational study was performed to investigate the potential of a modified gamma thermometer (GT) as both a local power level monitor and a sodium flow blockage monitor for a Liquid Metal Fast Breeder Reactor. This study consisted of two fundamental parts: a radiation field characterization and a thermal-hydraulic analysis. The radiation transport analysis was performed to determine the volumetric heat source within the GT resulting from gamma and neutron heating. Both fission-product decay gammas and neutron-induced gammas were treated in the analysis. The direct neutron heating effect was also included. The results of this preliminary study confirm the feasibility of utilizing the GT as an in-core local power level measurement device. However, the proposed signal for monitoring sodium flow blockage was shown to be insignificant and therefore uninterpretable. As a local power level monitor, however, the results provide encouragement and incentive to pursue the GT as a viable nuclear instrument.

23799 (DOE/ET/37240—109-PR) **Coolant mixing in LMFBR rod bundles and outlet plenum mixing transients. Final report.** Todreas, N.E.; Cheng, S.K.; Basehore, K. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Aug 1984. Contract AC02-76ET37240. 356p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85010336.

This project principally undertook the investigation of the thermal hydraulic performance of wire wrapped fuel bundles of LMFBR configuration. Results obtained included phenomenological models for friction factors, flow split and mixing characteristics; correlations for predicting these characteristics suitable for insertion in design codes; numerical codes for analyzing bundle behavior both of the lumped subchannel and distributed parameter categories and experimental techniques for pressure velocity, flow split, salt conductivity and temperature measurement in water cooled mockups of bundles and subchannels. Flow regimes investigated included laminar, transition and turbulent flow under forced convection and mixed convection conditions. Forced convections conditions were emphasized. Continuing efforts are underway at MIT to complete the investigation of the mixed convection regime initiated here. A number of investigations on outlet plenum behavior were also made. The reports of these investigations are identified.

2107 Regulation And Licensing

23800 (EGG-EA—6749) **Conformance to Regulatory Guide 1.97, Comanche Peak Steam Electric Station, Unit Nos. 1 and 2 (Docket Nos. 50-445 and 50-446).** Udy, A.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1985. Contract AC07-76ID01570. 22p. NTIS, PC A02/MF A01 - GPO. File Number TI85008937.

This EG and G Idaho, Inc. report reviews the submittals for the Comanche Peak Steam Electric Station, Unit Nos. 1 and 2, and identifies areas of conformance to Regulatory Guide 1.97. Any exceptions to these guidelines are evaluated.

2108 Economics

REFER ALSO TO CITATION(S) 23785, 23795

23801 (DOE/ER/10275—1C, pp 1, Paper 47) **Financing of nuclear utilities.** Thomson, K. (Lowell Univ., MA). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The cost of building a nuclear power plant today is skyrocketing due to rising interest rates and production delays. This paper will focus on the costs to the utility due to these economic conditions and how utilities are coping with rising costs.

23802 (EPRI-NP—3873) **Analytic simulator qualification methodology.** Kraje, B.; Smith, L.; Snidow, N. (Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div.). Mar 1985. 231p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $20.50. File Number TI85920563.

Notwithstanding the existence of a standard power plant training simulator acceptance criteria document, there is a continuing industry dialogue on the needs and merits of various improvements in simulator qualification. One recurring theme addresses the need to correlate model qualification requirements with training requirements. The basic objective of this project is the development of such an improved model qualification methodology, and identification of model development needs, based on this training objective perspective. This report presents the proposed improved criteria and methodology as developed to date and discusses their initial test-case application to two training simulator scenarios.

23803 **(UNI-SA—135) Use of standard computer terminal for the instructor console on a real-time nuclear reactor training simulator.** Gannon, L.L. (Boeing Computer Services Co., Richland, WA (USA)). 21 Dec 1984. Contract AC06-76RL01857. 3p. (CONF-8503113—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008435.

From Eastern simulation conference; Norfolk, VA, USA (3 Mar 1985).

The advantages of using low cost computer terminal for the Instructor Console on a real-time nuclear simulator are presented in this paper. The original Simulator Design Criteria called for a special Instructor Console Station, consisting of three color CRTs and a dedicated computer. This paper discusses the decision to replace the Instructor Console with low cost terminals (or IBM PCs) interfaced directly to the main simulator computer. This decision coupled with the modular design of the software provides many advantages, including less software development time, less hardware/software maintenance and multiple low cost terminal available for concurrent development, testing and training.

23804 **Economic benefits of the nuclear power.** Sutherland, R.J. (Los Alamos National Lab., NM). *Energy Systems and Policy;* 9: No. 1, 89-114(1985).

The historical and projected benefits of nuclear power are estimated as the cost differential between nuclear power and an alternative baseload generating source times the quantity of electricity generated. From 1976 through 1981 coal and nuclear power were close competitors in most regions, with nuclear power holding a small cost advantage overall in 1976 and 1977 that subsequently eroded. When nuclear power costs are contrasted to coal power costs, national benefits from nuclear power are estimated to be $336 million from 1976 to 1981, with an additional $1.8 billion for the present value of existing plants. Fuel oil has been the dominant source of baseload generation in California, Florida, and New England. When nuclear power costs are contrasted to those of fuel oil, the benefits of nuclear power in these three regions are estimated to be $8.3 billion and $28.1 billion in terms of present value. The present value of benefits of future nuclear plants is estimated to be $8.2 billion under a midcase scenario and $43 billion under an optimistic scenario. 18 references, 10 tables.

2109 Process Heat Reactors

23805 (DOE/ER/10275—1C, pp 1, Paper 49) **Use of small high temperature gas-cooled reactors for commercial applications.** Reckley, W. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The rising cost of fossil fuels and electricity purchased from the normal utility systems have forced large energy users to search for new methods of energy supply. This paper examines the possible use of a High Temperature Gas-Cooled Reactor to supply electricity and steam to serve the University of Maryland College Park Campus. Energy demands, available technology and economics determine the benefits and problems associated with the use of small HTGR's for commercial applications such as serving as a total energy system for a large university of industrial complex.

23806 **(INIS-mf—9263) Allothermal water gas production from raw brown coal in rotary-drum tube gasifiers. A process using nuclear process heat.** Speicher, R.F. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bergbau und Huettenwesen). 6 Dec 1983. 498p. (In German). NTIS (US Sales Only), PC A21/MF A01. File Number DE85780864.

With 97 refs.

A process for allothermal water gas production from raw brown coal with the aid of nuclear process heat was developed and tested in a semitechnical experimental plant. The main results were: 1. Rhenish bog coal can be converted into a hydrogen- and CO-rich gas in inclined, circumferential tubes using the raw coal water as gasification agent. 2. The water gas produced by allothermal in parallel flow is tar-free at temperatures beyond 700°C. 3. The kinetics of the gasification process is determined not by the heat transfer to the reaction partners but by the kinetics of the chemical reactions. 4. The local carbon conversion rates are more strongly influenced by the temperature than by the local oxidation potential of the gas phase. 5. The carbon conversion rates can be slightly raised by external steam supply, but also with comparatively small amounts of CO_2 supplied additionally. 6. The dusty gasification residues were found to absorb considerable amounts of sulphur from the raw gas.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

23807 (DOE/ER/10275—1C, pp 1, Paper 32) **Analysis of the core physics modelling of a nuclear power plant simulator.** Ortega, A. (North Carolina State Univ., Raleigh). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

A project has been initiated to determine the accuracy of the basic modelling and the input data of the reactor core physics models incorporated in a full scope nuclear power plant simulator, owned and operated by a North Carolina utility. The ore physics model predicts the core's power distribution, power level, and thermohydraulics conditions for normal and abnormal operating conditions. This paper attempts to present the basis of the reactor core physics modelling and the potential areas of concern as identified by comparison of simulator versus benchmark predictions.

23808 **(LA—10271-PR) Radiation transport. Progress report, January 1-March 31, 1984.** O'Dell, R.D. (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010333.

Research and development progress in radiation transport by the Los Alamos National Laboratory's Group X-6 for the second quarter of FY84 is reported. Included are unclassified tasks in the areas of Fission Reactor Neutronics, Deterministic Transport Methods, Monte Carlo Radiation Transport, and Cross Sections and Physics.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 23823, 24034, 24099, 24232

23809 (DOE/ER/10275—1C, pp 1, Paper 39) **Study of a boronometer.** Kelly, D.; Munno, A.; Stroube, K. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

An experimental simulation of a neutron boronometer was performed, reason being that there is hope of improving such a device for use in fission reactors. The importance of a neutron boronometer is heightened during refueling and potential boron dilution episodes. The safety significance is, of course, avoiding inadvertant criticality. The apparatus used was a Pu-Be neutron source suspended in the center of a 4800 ml beaker. A BF_3 filled tube was used as a neutron detector. The beaker was filled with water, and boron conentrations were varied by simple addition of boric acid. The experimental results were compared with ANISN calculations. The calibration of the boronometer would depend on the precision with which ANISN calculations would model experimental results.

23810 (DOE/ER/10275—1C, pp 1, Paper 57) **Carbon-vacancy interactions in a neutron-irradiated nickel-carbon solid solution.** Richardson, R.E. (Virginia Univ., Charlottesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The effects of room temperature neutron irradiation and subsequent annealing on the properties of a nickel-0.3 wt. % carbon alloy were studied to provide information on the types of defect interactions within the solid solution. Such interactions may play a role in the reduced swelling observed in neutron irradiated nickel base metals with increasing carbon content. The experiment involved microhardness measurements of carburized and uncarburized nickel samples following annealing between 200 and 1200°C. Tests were made on samples exposed to various fast neutron fluences (10^{17} to 4 x 10^{18} nvt) and unirradiated samples. The data show two major effects. First, room temperature irradiation appears to reduce the mobiity of carbon at temperatures below approximately 225°C. Second, irradiation enhanced the normal decomposition of the supersaturated nickel carbon solid solution which occurs between 225 and 600°C.

23811 (DOE/ER/10275—1C, pp 1, Paper 60) **Experimental methods for measuring residual unspecified elements of reactor pressure vessel steels.** de Hodgins, O.C. (Virginia Univ., Charlottesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The materials of this study are shop fabrication from plates and welds (Type A533-B) GW 44 and BP6 low alloy steels of nickel and modified manganese-molybdenum. These steels are designed to operate at 550°F (288°C) for a projected lifetime of 40 years. During this time the neutron exposure may reach fluences as great as 6 x 10^{19} n/cm^2 (E = 1 MeV). Auger electron spectroscopy specimens of GW 44 and BP6 were prepared in a tensile specimen of 7 mm long and 1 mm in diameter. They were fractured at 20°C and fracture surfaces were mounted in the Auger electron microscope and analyzed under high vacuum. Analysis was performed on the intergranularly fractured surfaces using a cylindrical mirror analyzer with a primary beam energy of 5 keV, a beam current of 0.1 μA and an incident electron probe size of 3 μm. Differentiated energy spectra (dn(e)dE) were recorded over the energy range 40 to 1040 eV from samples of each alloy. The analysis revealed the solute segregation distribution of alloying elements and impurities on both the plate and the weld was found on the weld (GW 44). The depth profile indicated the presence of Cu on both the plate and the weld.

23812 (NUREG/CR—4070-Vol.3) **Bivalve fouling of nuclear power plant service-water systems: factors that may intensify the safety consequences of biofouling. Volume 3.** Henager, C.H. Sr.; Daling, P.M.; Johnson, K.I. (Pacific Northwest Labs., Richland, WA (USA)). Apr 1985. Contract AC06-76RL01830. 58p. (PNL—5300-Vol.3). NTIS, PC A04/MF A01 - GPO $4.50. File Number TI85010466.

This report describes the safety and economic consequences of bivalve fouling in raw-water systems at nuclear power plants. The report lists events that could cause a normal fouling situation to become more critical and describes scenarios in which bivalve fouling could cause unsafe or unwanted conditions such as transients and shutdowns. Several fouling events that have occurred at various nuclear plants are briefly reviewed, and recommendations are made to aid in the detection and control of bivalve fouling.

23813 (NUREG/CR—4170) **Ultra-high speed residue processor for SAFT inspection system image enhancement. Final report, October 1983-March 1984.** Polky, J.N.; Miller, D.D. (Sigma Research, Inc., Seattle, WA (USA). Seattle Lab.). Mar 1985. 40p. NTIS, PC A03/MF A01 - GPO $3.75. File Number TI85901284.

The Phase-I feasibility study of residue number system (RNS) image processing for SAFT inspection has successfully determined that an advanced inspection system may be built using a correlation-reconstruction SAFT algorithm, implemented with RNS techniques and off-the-shelf electronic components. Images are reconstructed in a number theoretic transform domain with simple pointwise multiplication of the A-scan data volume by a custom point spread function (PSF), all in a highly parallel computational architecture. These methods also allow image enhancement to be easily performed for improved flaw visualization, and with negligible speed reduction. It has been determined that high resolution three dimensional flaw images may be generated and that a commercially viable product could result through development of a prototype real-time RNS processor. The hardware is expected to be made up of 100 nsec bit slice microprocessor components and large RAM storage units. Such a processor would provide the NDE community with a valuable new tool, that could generate significant improvements in real-time flaw visualization of critical components encountered in nuclear power plant inspection. Special inspection conditions, such as multiple reflections and crack tip detection in the presence of corner reflecting effects, may be overcome by modifying the functional form of the PSF. It is also possible that semi-automatic flaw classification could be included in the process without significantly adding to the computational burden. Based on the performance estimates of the Phase-I effort, this new image processing system has the potential to acquire and focus the equivalent of 145 A-scans per second, which translates into more than 1000 in.^{2}/min inspection rate for typical pressure vessel specimens.

23814 (TVA/PUB—85/21) **Seismic pipe support construction practices.** Brothers, T.M.; Rudolphi, M.U. (Tennessee Valley Authority, Knoxville (USA)). 1985. 6p. NTIS, PC A02/MF A01. File Number DE85901315.

During the mid 1970's the regulatory agencies controlling the design and construction of nuclear power plants began to demand stricter adherence to already existing codes and standards in addition to evoking new requirements. This increased scrutiny in addition to the advent of the NF subsection of the ASME code brought pipe hangers into the spotlight of nuclear plant design and construction. What before had been a minor item of low visibility became a monster causing plant delays and cost overruns. This document details some of the problems, their origins, and suggestions to reduce their impact.

2204 Control Systems

23815 (CONF-850841—1) **Combination of artificial intelligence and procedural language programs in a computer application system supporting nuclear reactor operations.** Stratton, R.C.; Town, G.G. (Argonne National Lab., Idaho Falls, ID (USA); Central Washington Univ., Ellensburg (USA). Dept. of Computer Science). 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85007944.

From Workshop on coupling symbolic and numeric computation in expert systems; Bellevue, WA, USA (27 Aug 1985).

A computer application system is described which provides nuclear reactor power plant operators with an improved decision support system. This system combines traditional computer applications such as graphics display with artifical intelligence methodologies such as reasoning and diagnosis so as to improve plant operability. This paper discusses the issues, and a solution, involved with the system integration of applications developed using traditional and artificial intelligence languages.

23816 (DOE/ER/10275—1C, pp 1, Paper 8) **Safety parameter display system for Georgia Power's Plant Hatch.** Wolford, A.J. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

As a result of lessons learned at TMI, much emphasis has been placed on improving emergency response to incidents in operating nuclear power plants. Georgia Power Company has initiated, with Georgia Tech, a program to equip their Plant Hatch Units I and II with a group of Emergency Response Facilities (ERF's) as outlined in NRC NUREG-0696. One ERF included in this group is the Safety Parameter Display System (SPDS), and it is, to date, unique in concept and design. The SPDS is a seismically-qualified computer system designed for real-time monitoring of plant safety status. It is to be an assistive tool to operations in mitigating accidents by providing sufficient information to rapidly and accurately diagnose system malfunctions or improper operations. The SPDS will provide operators with three levels of information display. Level one is a continuous display set of plant safety parameters. Level two expands level one information into: (a) time plots of the

parameters; and (b) diagnostics for this set. Level three displays are parameter vs parameter plots necessary to support the BWR Owners Group Emergency Procedure Guidelines.

23817 (DOE/ER/10275—1C, pp 1, Paper 9) **Applicability of expert system for nuclear power plant diagnostics.** Machado, E.L.; Soares, A.J. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

A production system specialized in the diagnosis of anomalies in the primary system of a nuclear power plant is described. The system not only automatically monitors the plant, watching for anomalous situations, but also it can isolate the source of an anomaly, and then explain the problem to a human operator in English, the actions to be taken, and its reasoning (how the rules were used in isolating the problem). The simplified model of a nuclear power plant used and the simple set of rules make the program not applicable to complex situations, but show how this type of system can be used as a tool to help plant operators. Some important features and characteristics of the program are discussed.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 23837, 24328

23818 (DOE/ER/10275—1C, pp 1, Paper 18) **Dynamic behavior of man-made radionuclides released from a nuclear power plant.** Theriault, P. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Samples of physical and biological media were collected from Monsweag Bay, the outflow estuary of the Maine Yankee Atomic Power Plant, and at a control site in the Damariscotta River. A cryogenic air sampler was designed, constructed and utilized to search for Xe-133 downwind from the plant. Concentrations of several radionuclides were observed and modelled using a previously developed pulse driven relaxator model. Comparisons were made for radionuclide trends in various species.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 23828

23819 (DOE/ER/10275—1C, pp 1, Paper 29) **Neutronic calculations for the proposed redesign of the University of Florida Training Reactor using SPERT Fuel.** Kniedler, G.S. (Florida Univ., Gainesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The University of Florida Training Reactor (UFTR) currently employs 93% enriched Uranium-Aluminum MTR plate-type fuel. Investigations are being performed to examine the feasibility of replacing the highly-enriched fuel of the current UFTR with 4.8% enriched, cylindrical pin, SPERT fuel. (SPERT is an acronym for Special Power Excursion Reactor Test.) This paper reports on the neutronics studies performed under this feasibility analysis. The thermal-hydraulics studies are reported in a separate paper.

23820 (DOE/ER/10275—1C, pp 1, Paper 30) **Automated power calibration system.** Munno, C.J. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The absolute power measurement of a nuclear reactor is essential to the proper operation of the nuclear reactor to ensure that it is operating within proper licensed bounds. Such a measurement can be made by measuring the rate of temperature increase at constant power input and correcting for heat loss. An automated power calibration system based on an APPLE II micro computer has been developed. Measurements performed on the University of Maryland Research Reactor are presented, and the data collection and analysis system is discussed.

23821 (DOE/ER/10275—1C, pp 1, Paper 36) **Thermal analysis for the University of Florida Training Reactor using SPERT fuel.** Hommerson, R. (Florida Univ., Gainesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The steady-state thermal-hydraulic analysis for the redesign of the University of Florida Training Reactor (UFTR) using SPERT fuel is presented. It is proposed that the high-enrichment MTR plate fuel currently in use in the UFTR be replaced with low enrichment SPERT, cylindrical fuel rods. The UFTR is under redesign consideration to decrease proliferation possibilities, to increase fuel availability, and to create a higher flux environment within the core. Two metal-to-water ratio designs have already undergone neutronic analysis and the thermal-hydraulic investigations focus on these configurations. Steady-state thermal design results presented include bulk coolant temperature limits, hottest fuel temperature limits, minimum DNBR, and coolant volumetric flow limits. Use of and modifications to the steady thermal-hydraulics code TEMPRET are discussed. Recommendations for further study and a brief outline of proposed transient analysis are presented.

23822 (DOE/ER/10275—1C, pp 1, Paper 56) **Thermal design and heat transfer analysis of a 1200 graphite irradiation-induced creep test capsule.** Mobasheran, A.S. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

This paper is concerned with the thermal design of a cylindrical irradiation-induced creep test capsule, designated the OC-6 capsule. The main purpose of the design is to make the capsule capable of maintaining a constant temperature of 1200°C within two graphite specimen columns, contained in the capsule, while being positioned in the Oak Ridge Research Reactor (ORR) core. Gamma heating is the only heat source in the capsule. The main goal of the thermal design has been achieved by incorporating some fixed- and variable-width annular gas gaps within the capsule and around the specimen columns, as well as a thermal radiation reflector around each column. The required gap widths, and their lengths, have been calculated. The overall level of temperature control has also been calculated for various He-Ne gas mixtures (sweep gas) which flow through the gas gaps.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 23803

23823 (CONF-8405192—, pp 45-48) **Solid state group report.** Rowe, J.M. (Oak Ridge Naitonal Lab., TN). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

Recommendations of the solid state working group at the workshop are summarized. The recommendations are aimed at ensuring a continuation and expansion of the large contribution of neutron scattering to studies of the physics of condensed matter. The types of instruments believed necessary for a new high intensity source are listed along with general requirements for each. They include: a large complement of triple axis spectrometers, three time-of-flight spectrometers, ultrahigh resolution spectrometers, diffuse scattering facilities, and a small angle scattering facility. Other general recommendations are also made.

23824 (CONF-8405192—, pp 1-12) **Progress report on reactor design.** Bartine, D.E. (Oak Ridge National Lab., TN). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

The goal of this project is to design and construct the world's best research reactor for three purposes - neutron scattering, isotope production, and materials irradiation. A rough outline of the proposed schedule indicates that in FY 84 and FY 85 efforts would concentrate on completing a feasibility study; in FY 86 through FY 88 efforts would focus on a conceptual design study, including a project proposal submission at the end of FY 87; engineering design and construction would be performed during FY 89 through FY 93; and reactor operation would begin in FY 94. The major options are to retrofit the existing facility or to have a totally new facility. The initial flux requirements for HFIR-II are given. The general philosophy for HFIR-II design is to design-in safety and simplicity of operation and maintenance to facilitate obtaining the required institutional approvals and to insure that the high availability achieved with HFIR is retained for experimental purposes.

23825 (CONF-8405192—, pp 13-20) **Experimental facilities.** Moon, R.M. (Oak Ridge National Lab., TN). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

The opportunity to provide new, improved experimental facilities in a new reactor is at least as important as the higher neutron flux expected from the reactor. Major reconstruction of an existing reactor or construction of an entirely new facility is necessary to take full advantage of recent technology advances. In the present preconceptual design phase of the HFIR-II project both of these options will be considered. In this paper a general description of the modified HFIR is presented with some indications of the additional facilities that might be available in an entirely new facility. The paper discusses the proposed neutron beam facilities for scattering experiments and for nuclear physics. Also to be provided are improved facilities for isotope production, for materials irradiation, and for neutron activation analysis. Additional facilities to be considered include γ-ray diffraction, positron production, depth profiling, and neutron radiography.

23826 (CONF-8405192—, pp 21-28) **Scintillation neutron detectors.** Davidson, J.B. (Oak Ridge National Lab., TN). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

Two basic types of scintillation area neutron detectors are reviewed. The first is the prompt detector which uses photomultipliers (PM) to convert the neutron scintillations to electrical pulses. These signals are combined in weighting or encoding circuits to give event location. Then the number in the corresponding address in a computer memory is incremented. Both timing and amplitude information are available. Timing is necessary for energy measurements by time-of-flight when using pulsed sources. The amplitude information is useful for background discrimination. Several embodiments of the weighted and coded scintillator approach are mentioned. The second type of scintillation detector is based on television techniques and has a delayed readout. It is discussed in more detail.

23827 (CONF-8405192—, pp 29-30) **Present status and future promise of gas-filled position-sensitive neutron counters at ORNL.** Kopp, M.K. (Oak Ridge National Lab., TN). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

Recent developments at ORNL in the field of gas-filled proportional counter cameras for X-ray and neutron scattering experiments are briefly discussed. The upgrading of two small-angle neutron scattering cameras operating at HFIR and ORR, is discussed. The author believes that basic research in the field of neutron counter cameras is urgently needed for a systematic study of neutron counting gas properties, new position; encoding methods, and improved data processing methods.

23828 (CONF-8405192—, pp 31-44) **Instrumentation at the ILL: development and demand.** Hayter, J.B. (Institut Laue-Langevin, Grenoble, France). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

The Institut Max von Laue - Paul Langevin (ILL) was founded to provide a unique neutron beam facility for condensed matter, chemistry, biology, nuclear and fundamental physics, and materials' science research. The general layout of the main ILL facilities, the beam-tube arrangement, and fluxes in typical beams and guides are diagrammed. At present, there are 56 instruments installed, of which 34 are fully supported by ILL and available to external users. The remaining 22 special instruments are often installed by external laboratories and are mostly unavailable to users. The user program is described, and planned research efforts in the areas of cold neutron instruments, data acquisition systems, and sample response to real-time perturbations are briefly noted.

23829 (CONF-8405192—, pp 49-54) **Chemistry group report.** Rush, J.J. (Oak Ridge National Lab., TN). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

Recommendations of the chemistry working group at the workshop are based on an assessment of what appear to be the most important areas of chemical research with neutrons in the future and projected instrumentation needs. Recommendations are divided into three categories: crystal and molecular structure, submicron structure, and chemical dynamics and spectroscopy.

23830 (CONF-8405192—, pp 55-58) **Materials science and the amorphous state group report.** Wagner, C. (Univ. of California, Los Angeles). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

Specific neutron scattering applications in materials science include 1) phase transformations at elevated temperatures and at high pressures, 2) lattice strain effects, and 3) polycrystalline texture. Recommendations of the materials science and amorphous state working group at the workshop are summarized with the note that development of needed instrumentation can be realized by designing around present day facilities prior to construction of planned high-flux reactor facilities.

23831 (CONF-8405192—, pp 59-64) **Polymer group report.** Stein, R.S. (Univ. of Massachusetts, Amherst). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

Recommendations of the polymer working group at the workshop are summarized with emphasis on a new small angle scattering facility.

23832 (CONF-8405192—, pp 65-68) **Biology group report.** Moore, P.B. (Harvard Univ., Cambridge, MA). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

The biology working group at the workshop anticipates that four kinds of instruments would be required by biological users at the advanced HFIR. These are described in order of priority: protein crystallography station, small angle neutron scattering facility, a general purpose spectrometer, and a dedicated, biological inelastic spectrometer.

23833 (CONF-8405192—, pp 69-72) **Neutron optics group report.** Werner, S.A. (Univ. of Missouri, Columbia). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

Neutron optical techniques play a central role in all aspects of neutron scattering research, from the precise measurements of nuclear scattering amplitudes to questions addressing the foundations of physics. Of particular relevance to the development of new experimental facilities, however, is the importance they play in the technology needed to extract, filter and monochromate intense beams of neutrons. Recommendations of the neutron optics working group at the workshop are summarized.

23834 (CONF-8405192—, pp 73-78) **Nuclear physics group report.** Wilson, R. (Harvard Univ., Cambridge, MA). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

The nuclear physics working group at the workshop concerned itself not only with instrumentation for standard nuclear physics experiments, but it expanded its charge to also consider properties of the neutron, and fundamental interactions. The physics interest recommendations are divided into three parts: (1) properties of the neutron, (2) fundamental interactions, and (3) standard nuclear physics.

23835 (CONF-8405192—, pp 79-81) **Summary of workshop recommendations.** Moon, R.M. (Oak Ridge National Lab., TN). 30 May 1984. NTIS, PC A05/MF A01. File Number DE85001458.

From Workshop on instrumentation for the advanced high flux reactor; Oak Ridge, TN, USA (30 May 1984).

The recommendations by the various groups regarding instrumentation are summarized. There are a total of 39 instruments or experimental stations listed; 19 requiring a cold beam, 16 requiring a thermal beam, and 4 requiring a hot beam. The workshop groups also made a number of more general recommendations, the most popular of which are: 1) An entirely new reactor facility, rather than a modified HFIR, should be constructed. 2) An instrument and ancillary development program should be established soon. 3) A large selection of ancillary equipment should be provided for routine use by visitors in controlling their sample environment.

23836 **(DP-MS—84-101) Process calculations for a moderator detritiation plant.** Rodman, M.; Howard, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1985. Contract AC09-76SR00001. 6p. (CONF-850405—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008258.

From 2. national topical meeting on tritium technology in fission, fusion and isotopic applications; Dayton, OH, USA (30 Apr 1985).

The Savannah River Plant is currently analyzing processes for the removal of tritium from the heavy water used as a moderator in SRP's nuclear reactors. An accompanying paper describes the background and need for this process. A computer-aided design program was used to simulate the distillation section of the detritiation process flowsheet. Simplified calculation techniques were performed to optimize the process parameters. Results obtained are being used to evaluate proposals from various vendors.

23837 **Phytoplankton distribution in three thermally distinct reactor cooling reservoirs.** Wilde, E.W. (E.I. du Pont de Nemours & Co., Aiken, SC). *Transactions of the American Microscopical Society;* **102**: No. 2, 145-164(1983). Contract AC09-76SR00001.

Phytoplankton community structure was studied in relation to physicochemical characteristics of three South Carolina reservoirs in close proximity and of similar age and bottom type. Thermal alteration, resulting from the input of cooling water from a nuclear reactor, was substantially different in each reservoir. This provided an opportunity to compare water temperature effects separated from season. Water temperature (when examined independently in statistical models) appeared to be less important than other environmental variables in determining phytoplankton community structure. Pond C, a reservoir receiving intensely heated effluent ($> 20°C \Delta T$), displayed low species diversity (Shannon-Weaver H < 2.0), except in winter. Unexpectedly, more than 50% of the total phytoplankton density in this reservoir was consistently comprised of green algae (principally Chlamydomonas sp.) despite water temperatures that averaged 47.3°C in summer. Par Pond, having a maximum ΔT of 5°C, displayed no temperature-induced alteration of phytoplankton community structure.

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REFER ALSO TO CITATION(S) 23816, 24306, 24397

23838 **(ANL/EES-TM—275) Source-term reevaluation for US commercial nuclear power reactors: a status report.** Herzenberg, C.L.; Ball, J.R.; Ramaswami, D. (Argonne National Lab., IL (USA)). Dec 1984. Contract W-31-109-ENG-38. 99p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85010195.

Only results that had been discussed publicly, had been published in the open literature, or were available in preliminary reports as of September 30, 1984, are included here. More than 20 organizations are participating in source-term programs, which have been undertaken to examine severe accident phenomena in light-water power reactors (including the chemical and physical behavior of fission products under accident conditions), update and reevaluate source terms, and resolve differences between predictions and observations of radiation releases and related phenomena. Results from these source-term activities have been documented in over 100 publications to date.

23839 **(DOE/ER/10275—1C) Transactions of the 1982 Eastern Regional American Nuclear Society student conference.** (Georgia Inst. of Tech., Atlanta (USA)). 1982. Contract FG02-82ER10275. 85p. (CONF-820442—Absts.). NTIS, PC A05/MF A01. File Number DE83004082.

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The 1982 Eastern Region ANS Student Conference of the ANS Student Branch and the School of Nuclear Engineering and Health Physics was held at Georgia Tech., April 16-17, 1982. Almost all the papers have been entered individually into EDB and ERA. (LTN)

23840 (DOE/ER/10275—1C, pp 1, Paper 1) **Droplet deposition above a quench front during reflood after a large break LOCA.** Lee, R. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Droplet deposition or migration towards the wall in a dispersed flow has been the subject of many investigations due to its industrial applications such as combustion of sprays of liquid fuel, evaporators, spray cooling, nuclear reactors, etc. Dispersed flow is characterized by high void and hence low droplet concentration and the theoretical study of droplet deposition is the treatment of a single droplet trajectory in the dispersed. As the droplet is travelling towards the wall, whether it will eventually be deposited on the wall or not, will be determined by the competing forces acting on it and by the boundary layer it is traversing through towards the wall. The mechanism of droplet deposition will be examined. The prediction of the boundary layer thickness will take into account the droplet size and density difference between the fluid and the droplet. Given the condition above the quench front, the minimum lateral velocity required for droplet deposition could be determined as a function of droplet diameter.

23841 (DOE/ER/10275—1C, pp 1, Paper 2) **Size and number density change of droplet populations above a quench front during reflood in a PWR after a large break LOCA.** Lee, R. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The dispersed flow regime above a quench front during reflood in a PWR after a large break LOCA, cannot be described

adequately by employing a single averaged drop size. This is due to the fact that two distinct droplet generation mechanisms are present (Fragmentation of the bubble film and hydrodynamic) leading to a bi-spectral droplet distribution. The evaporation rate of these droplet populations is analyzed by taking into account the relevant convective and radiative heat transfer mechanisms. It is found that the droplet population changes significantly between the point of creation of the droplets and the next channel restriction. The rapid evaporation and diminishing of the small droplet spectrum could explain the exponential rate of energy transfer from the cladding surface in the vicinity above the quench front.

23842 (DOE/ER/10275—1C, pp 1, Paper 3) **Theoretical study of mixed convection effects on heat transfer to steam in rod bundle geometry.** Sozer, A. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Under certain small break LOCA scenarios, the nuclear reactor core is expected to uncover partially under a slow quasi-steady boiloff transient. In the uncovered rod bundle region, heat is transferred to low flow superheated steam by convection and radiation. Since this is the only region having potential to give thermal damage to fuel during an accident, heat transfer and fluid flow conditions need to be determined. In this steam cooling region, heat transfer is expected to be accomplished by laminar flow. However, experimental results indicated higher heat transfer rates than those expected for laminar flow below a Reynolds number equal to 2000. The possible cause for high heat transfer coefficients may be transition from forced to mixed (forced and free) convection. This project is a theoretical study of the buoyancy effects on heat transfer to superheated low flow steam flowing upward in rod bundle geometry.

23843 (DOE/ER/10275—1C, pp 1, Paper 4) **Long term modeling of pressure suppression pool dynamics.** Cook, D.H. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The key to the safety of a BWR is the large thermal capacitance provided by the pressure suppression pool (PSP). The PSP is designed to quickly and completely condense any steam released from the reactor pressure vessel through relief valve tailpipes located throughout the pool. Unfortunately, there exist severe accidents during which the PSP may not perform this function. One such severe accident is the complete station blackout. In the past, analyses of PSP dynamics have treated the pool as a single, well-mixed node characterized by a bulk temperature. This is grossly inadequate for the transient described above. Therefore, the primary objective of the present study is to develop a computational model for PSP dynamics during severe accident conditions. The important safety question to answer is the following. Will primary containment fail early in a station blackout due to overpressurization that is caused by local heatup of the pool. A second objective of the work is to verify the above model using experimental data. Many small scale and a few large scale plant tests exist where the effects of a single safety relief valve discharging into a quiescent pool were studied.

23844 (DOE/ER/10275—1C, pp 1, Paper 5) **Bond graph model for prediction of PWR natural circulation.** Kao, S.P. (Massachusetts Institute of Technology, Cambridge). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

In operation of a Pressurized Water Reactor, natural circulation is an efficient, passive heat transfer mechanism for cooling. It is often employed for heat removal in operational transients, especially in long-term decay-heat removal operation. To simulate the dynamics of natural circulation, a bond graph representation of the PWR primary system and causal manipulation of the field equations has been modeled. The bond graph method calls for establishing the dynamic equations of multiport systems in state-variable form. Using the analogy of circuit elements in electrical networks, a bond graph consists of multiport capacitances, inertances, dissipations, sources of effort and flow, transformers, gyrators, and ideal junction elements. By treating each component in a PWR primary loop as a multiport element in the bond graph, a set of state-space equations representing the thermal/hydraulic responses of the loop is obtained. The state equations are then solved iteratively by using the program DYSIS developed by MIT.

23845 (DOE/ER/10275—1C, pp 1, Paper 6) **Core debris/water heat transfer modeling effects on LWR containment overpressure.** Medek, D.A. (Massachusetts Institute of Technology, Cambridge). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

During the late stages of a postulated degraded core accident (DCA) in a light water reactor, heat transfer from the core debris is of primary concern in determining the transient containment pressure. This paper discusses the effects of various debris/water interaction models on predicted containment pressure histories. At present, the principal computer code available for modeling a light water reactor meltdown is the MARCH code. This code utilizes a lumped parameter core debris/water heat transfer model based on uniformly-sized, thermally noninteracting spheres. In the present work, three dryout heat flux models derived for hydrodynamic two-phase flow through packed particle beds have been incorporated into the MARCH code; in addition, a phased debris dispersal model is being developed for future utilization.

23846 (DOE/ER/10275—1C, pp 1, Paper 7) **Systems interactions analysis: concepts and techniques.** Muhlheim, M.D. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Systems Interactions Analysis is an important extension to the Probabilistic Risk Assessment method used in the Reactor Safety Study (WASH-1400). Systems Interactions Analysis (SIA) studies the coupling of engineered safety features through shared support systems, maintenance activities and operational procedures. The method employs the use of a transformed fault tree, called a Systems Interactions fault tree. This fault tree is obtained by modifying the standard fault tree to include potential system interactions candidates. A preliminary Systems Interactions analysis of the Clinch River Breeder Reactor Shutdown Heat Removal System (CRBRP SHRS) aided in testing this methodology. The Systems Interactions analysis demonstrated that the Shutdown Heat Removal System is not as redundant as previous studies indicated. In addition, this study verifies that a previously recognized dependent in the Shutdown Heat Removal System between the Primary Heat Transport System and the Direct Heat Removal System is greater than anticipated.

23847 (DOE/ER/10275—1C, pp 1, Paper 10) **Flood risk analysis procedure for nuclear power plants.** Wagner, D.P. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

This paper describes a methodology and procedure for determining the impact of floods on nuclear power plant risk. The procedures are based on techniques of fault tree and event tree analysis and use the logic of these techniques to determine the effects of a flood on system failure probability and accident sequence occurrence frequency. The methodology can be applied independently or as an add-on analysis for an existing risk assessment. Each stage of the analysis yields useful results such as the critical flood level, failure flood level, and the flood's contribution to accident sequence occurrence frequency. The results of applications show the effects of floods on the risk from nuclear power plants analyzed in the Reactor Safety Study.

23848 (DOE/ER/10275—1C, pp 1, Paper 11) **Analysis of delay fault tree logic: methods and nuclear systems safety applications.** Arendt, J.S. (Tennessee Univ., Knoxville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

This paper presents details of new methods for the analysis of delay logic in nuclear power plant safety and probabilistic risk assessment (PRA). Fault trees, a frequently used tool in these studies, model the possible combination of equipment and human malfunctions that could cause safety system failures. This presentation will discuss the basis of the new methods, their assumptions and limitations, and provide a brief overview of a specific recent nuclear plant application.

23849 (DOE/ER/10275—1C, pp 1, Paper 16) **Index for increasing public comprehension of radiation risks.** Westerman, A.E. (Lowell Univ., MA). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

In the event of the release of radiation from a power plant, the public must know how to react to the released dose. With a proper 'radiation index' the public can put the said dose in fair perspective with known radiation sources and thus take proper action. This paper will present an example of a radiation index that may be used for public information.

23850 (DOE/ER/10275—1C, pp 1, Paper 17) **Evacuation plans at Seabrook.** Lacerte, A. (Lowell Univ., MA). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

One area of concern in Nuclear Power Plant operations is the adequacy of emergency evacuation procedures. In the event of an accident with potential off-site consequences, the public in the immediate vicinity of the plant would have to be evacuated. This paper will discuss the plans for such an evacuation as they pertain to the Seabrook Nuclear Power Plant.

23851 **(DOE/SF/10754—T4) Nuclear safety code study.** Jackson, C.; Haslett, R.; Abumansoor, K.; Jespersen, D.; Cramer, E.; O'Reilly, B.; Carmichael, B. (Claremont Graduate School, CA (USA); Harvey Mudd Coll., Claremont, CA (USA)). Jan 1980. Contract FG03-79SF10754. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010424.

Rockwell Energy Systems Group is currently developing a model of an overpower accident. It is the responsibility of this year's Nuclear Safety Code Study team to develop a useable algorithm for numerical evaluation of the stiff equations which are expected to constitute a majority of the model. In an overpower accident, it is hypothesized that an increased amount of radioactivity has accidently been added to the reactor core. It is further hypothesized that all back-up systems for shutting down the reactor in such an event have failed, and that nothing has been done to stop the natural course of events. The increased radioactivity will cause fuel temperature to rise, and subsequent melting of fuel will occur. It is supposed that the temperature increase will be so dramatic that fuel containers will develop weaknesses and melted fuel will spray out into the surrounding coolant. These events are described in detail in this report.

23852 **(EGG-RST—6833) First intermediate break test 6IB1 data comparison with a TRAC-BD1/MOD1 blind calculation.** Wheatley, P.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1985. Contract AC07-76ID01570. 47p. NTIS, PC A03/MF A01. File Number TI85010130.

TRAC-BD1/MOD1 has been used to calculate the behavior in the FIST (Full Integral Test Facility) facility during an intermediate break in one of the recirculation loops. Results of the calculation are compared with the data from the experiment, and the analysis is discussed in this report. The calculation was blind with only the initial and boundary conditions available prior to performance of the calculation. The calculation has been previously documented without reference to the experimental data (i.e., prior to release of the data). This report extends the prior report by discussing the analysis of the data to code comparisons. This work was performed as part of the Nuclear Regulatory Commission's support to the FIST program which is being provided at the Idaho National Engineering Laboratory.

23853 **(INIS-mf—9270) Investigations on construction material and construction concepts in order to obtain dose-reducing effects in the dismantling of the biological shield of a 1300 MWe-PWR. Final report.** Bittner, A.; Jungwirth, D.; Knell, M.; Schnitzler, L. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Dyckerhoff und Widmann A.G., Muenchen (Germany, F.R.). Abt. Forschung, Entwicklung und Qualitaetssicherung). Apr 1984. 160p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780863.

With 20 refs., 4 tabs., 59 figs.

Numerical values of neutron fluxes, activations, dose rates etc. as a function of characteristic values of materials required for optimization purposes to reduce the radiation effect of the biological shield of a PWR are not available. Design concepts are presented for biological shields of PWRs made of concrete with respect to both the most suitable application of materials and the design principles aiming at reduced radiation exposure as compared to present designs during entering, waste disposal and ultimate storage. To evaluate the present-state design the above values have been calculated. Suggested alternative designs are given for biological shields with selective material application, built from precast elements with or without boron carbide layer arranged in front of it.

23854 **(NUREG—0713-Vol.5) Occupational radiation exposure at Commercial Nuclear Power reactors 1983. Volume 5. Annual report.** Brooks, B.G. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Mar 1985. 128p. NTIS, PC A07/MF A01 - GPO $5.00. File Number TI85901261.

This report presents an updated compilation of occupational radiation exposure at commercial nuclear power reactors for the years 1969 through 1983. The summary based on information received from the 75 light-water-cooled reactors (LWRs) and one high temperature gas-cooled reactor (HTGR). The total number of personnel monitored at LWRs in 1983 was 136,700. The number of workers that received measurable doses during 1983 and 85,600 which is about 1000 more than that found in 1982. The total collective dose at LWRs for 1983 is estimated to be 56,500 man-rems (man-cSv), which is about 4000 more man-rems (man-cSv) than that reported in 1982. This resulted in the average annual dose for each worker who received a measurable dose increasing slightly to 0.66 rems (cSv), and the average collective dose per reactor increasing by about 50 man-rems (man-cSv), and the average collective dose per reactor increasing by about 50 man-rems (man-cSv) to a value of 753 man-rems (man-cSv). The collective dose per megawatt of electricity generated by each reactor also increased slightly to an average value of 1.7 man-rems (man-cSv) per megawatt-year. Health implications of these annual occupational doses are discussed.

23855 **(NUREG—0797-Suppl.9) Safety Evaluation Report related to the operation of Comanche Peak Steam Electric Station, Units 1 and 2 (Docket Nos. 50-445 and 50-446). Supplement No. 9.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 162p. NTIS, PC A08/MF A01 - GPO $6.00. File Number TI85901305.

This supplement addresses TUEC's analyses in support of its request to amend the Comanche Peak Final Safety Analysis Report to eliminate the commitment that coatings inside the reactor Containment Building be qualified for Units 1 and 2. In addition, this supplement provides the results of the staff's evaluation and resolution of 62 technical concerns and allegations in the coatings area for Unit 1. Because of the favorable resolution of the items discussed in this report, the staff concludes for the issues considered herein, that there is reasonable assurance that the facility can be operated by TUEC without endangering the health and safety of the public.

23856 (NUREG—0847-Suppl.4) Safety Evaluation Report related to the operation of Watts Bar Nuclear Plant, Units 1 and 2 (Docket Nos. 50-390 and 50-391). Supplement No. 4. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Mar 1985. 46p. NTIS, PC A03/MF A01 - GPO $4.00. File Number TI85901262.

This report supplements the Safety Evaluation Report, NUREG-0847 (June 1982), Supplement No. 1 (September 1982), Supplement No. 2 (January 1984), and Supplement No. 3 (January 1985) issued by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission with respect to the application filed by the Tennessee Valley Authority, as applicant and owner, for licenses to operate the Watts Bar Nuclear Plant, Units 1 and 2 (Docket Nos. 50-390 and 50-391). The facility is located in Rhea County, Tennessee, near the Watts Bar Dam on the Tennessee River. This supplement provides recent information regarding resolution of some of the open and confirmatory items and license conditions identified in the Safety Evaluation Report.

23857 (NUREG—0887-Suppl.6) Safety Evaluation Report related to the operation of Perry Nuclear Power Plant, Units 1 and 2 (Docket Nos. 50-440 and 50-441). Supplement No. 6. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1985. 146p. NTIS, PC A07/MF A01 - GPO $5.50. File Number TI85901343.

Supplement No. 6 to the Safety Evaluation Report (NUREG-0887) on the application filed by the Cleveland Electric Illuminating Company on behalf of itself and as agent for the Duquesne Light Company, the Ohio Edison Company, the Pennsylvania Power Company, and the Toledo Edison Company (the Central Area Power Coordination Group or CAPCO), as applicants and owners, for a license to operate the Perry Nuclear Power Plant, Units 1 and 2 (Docket Nos. 50-540 and 50-441), has been prepared by the Office of the Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located in Lake County, Ohio, approximately 35 miles northeast of Cleveland, Ohio. This supplement reports the status of certain issues that had not been resolved at the time of publication of the Safety Evaluation Report and Supplement Nos. 1 through 5 to that report.

23858 (NUREG—1108) Radioactivity transport following steam generator tube rupture. Hopenfeld, J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Accident Evaluation). Mar 1985. 40p. NTIS, PC A03/MF A01 - GPO $3.75. File Number TI85901278.

A review of the capabilities of the CITADEL computer code as well as plant experience to project radioactivity releases following a steam generator tube rupture in PWR's shows that certain experimental data are needed for reliable off-site dose predictions. This article defines five parameters which are the key for such predictions and discusses the functional dependence of these parameters on various operational variables. The above parameters can be used in conjunction with CITADEL or they can be inserted in the appropriate equations which then conveniently can be programmed as a subroutine in thermal-hydraulic system codes. A joint Westinghouse, Electric Power Research Institute and Nuclear Regulatory Commission Program aimed at obtaining the five parameters empirically is described.

23859 (NUREG/BR—0051-Vol.6-No.5) Power Reactor Events, September-October 1984. Volume 6, No. 5. Massaro, S.A. (ed.). (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Mar 1985. 54p. NTIS, PC A04/MF A01 - GPO. File Number TI85901268.

This is a bi-monthly newsletter that compiles operating experience information about commercial nuclear power plants. This includes summaries of noteworthy events and listings and/or abstracts of USNRC and other documents that discuss safety-related or possible generic issues. It is intended to feed back some of the lessons learned from operational experience to the various plant personnel.

23860 (NUREG/CR—2000-Vol.3-No.11) Licensee Event Report (LER) compilation for month of November 1984. Volume 3, No. 11. (Oak Ridge National Lab., TN (USA)). Dec 1984. Contract AC05-84OR21400. 61p. (ORNL/NSIC—200-Vol.3-No.11). NTIS, PC A04/MF A01 - GPO. File Number TI85005009.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event data for each facility. Component, system, keyword, and component vendor indexes follow the summaries.

23861 (NUREG/CR—3721/1) Pressure measurements in a hydrogen combustion environment: hydrogen-air combustion test series 1 and 2 in the FITS tank. Volume 1. Roller, S.F. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 53p. (SAND—83-2621/1). NTIS, PC A04/MF A01 - GPO. File Number TI85009899.

Test series 1 and 2 examined the effects of a number of parameters on hydrogen-air combustion: the initial temperature and pressure of the gases, the effect of added steam or carbon dioxide as diluents, and the percent hydrogen in air. For tests in the range of 20% to 40% hydrogen in air, recorded peak pressures were equal to adiabatic, isochoric, complete combustion (AICC) values within an experimental error of 15%. This was contrary to the results of tests at a number of other facilities. The pre-ignition temperature had a strong effect on the peak pressure, while pre-ignition pressure in the range examined had no effect on combustion pressure ratios. Calculations showed that, although the effect of dynamic head on the peak pressure was a few percent or less, interactions of the wave preceding the flame front with the flame and with the vessel walls may be apparent in the experimental records.

23862 (NUREG/CR—3804-Vol.4) Physics of reactor safety. Quarterly report, October-December 1984. Volume IV. (Argonne National Lab., IL (USA)). Feb 1985. Contract W-31-109-ENG-38. 22p. (ANL—84-35-Vol.4). NTIS, PC A02/MF A01 - GPO. File Number TI85009875.

An evaluation has been made of heat transfer from oxide fuel to coolant in the annular flow regime of PLUTO2 based on the heat transfer solution for a semi-infinite slab. A continuing problem in both PLUTO2 and LEVITATE is generation of excessive sodium vapor by a transition to bubbly fuel flow when liquid sodium is still present, producing instant vaporization. We are currently forbidding such transitions. In regard to COMMIX single-phase development, most efforts were devoted to preparation of documentation and release of COMMIX-1B. In the two-phase development effort, we performed simulation of the 7-2/16 experiment of KNS series at KfK. Simulations were performed with "equilibrium model with slip" version SM(HEM) and "separated phase model" of COMMIX-2.

23863 (NUREG/CR—3816-2) Reactor safety research. Quarterly report, April-June 1984. Volume 30. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1984. Contract AC04-76DP00789. 212p. (SAND—84-1072-2). NTIS, PC A10/MF A01 - GPO. File Number TI85009655.

This report describes progress in a number of activities dealing with current safety issues relevant to both light water reactors (LWRs) and breeder reactors. The work includes a broad range of experiments to simulate accidental conditions to provide the required data base to understand important accident sequences and to serve as a basis for development and verification of the complex computer simulation models and codes used in accident analysis and licensing reviews. Such a program includes the development of analytical models, verified by experiment, which can be used to predict reactor and safety system performance under a broad variety of abnormal conditions.

23864 (NUREG/CR—3820-Vol.3) **Thermal/hydraulic analysis research program. Quarterly report, July-September 1984. Volume 3.** Thompson, S.L. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 80p. (SAND—84-1025/3). NTIS, PC A05/MF A01 - GPO. File Number TI85010514.

The TRAC-PF1/MOD1 independent assessment program is part of a multi-faceted effort to determine the ability of various systems codes to predict the detailed thermal/hydraulic response of LWRs during accident and off-normal conditions. This quarter, calculations are continuing for the PKL ID1 natural circulation test series, for LOBI large break test A1-04R and intermediate break test B-R1M, and for Semiscale intermediate break test S-IB-3 and feedwater line break test S-SF-3; some additional calculations are also being run for the horizontal stratified flow condensation tests. Work began on Semiscale steam line break test S-SF-5, LOFT large break test L2-5 and on a set of perforated plate CCFL separate effects tests done at Northwestern University.

23865 (NUREG/CR—3930) **Observed behavior of cesium, iodine, and tellurium in the ORNL fission product release program.** Collins, J.L.; Osborne, M.F.; Lorenz, R.A.; Norwood, K.S.; Travis, J.R.; Webster, C.S. (Oak Ridge National Lab., TN (USA)). Feb 1985. Contract AC05-84OR21400. 71p. (ORNL/TM—9316). NTIS, PC A04/MF A01 - GPO. File Number TI85007728.

A total of 26 commercial LWR fuel tests have been conducted at ORNL to investigate fission product release and behavior under accident conditions. About 30 supplementary tests have used fission product tracers to obtain additional information. This report presents the results of two recent control tests using radioactively tagged fission product species and compares these results with the behavior of the same species in previous fuel tests.

23866 (NUREG/CR—4064) **Structural response of large penetrations and closures for containment vessels subjected to loadings beyond design basis.** Kulak, R.F.; Hsieh, B.J.; Ash, J.E.; Kennedy, J.M.; McLennan, G.A.; Pan, Y.C. (Argonne National Lab., IL (USA)). Feb 1985. Contract AC04-76DP00789;W-31-109-ENG-38. 117p. (SAND—84-7177; ANL—84-41). NTIS, PC A06/MF A01 - GPO. File Number TI85010460.

The Reactor Analysis and Safety Division (RAS) and the Components Technology Division (CT) of Argonne National Laboratory (ANL) are performing analytical/numerical simulations of the response of selected large penetrations and closures, which use some type of seal or gasketed joint, for containment vessels subject to pressure and thermal loads that are beyond the design basis (BDB). The objectives of this task were to identify the methodology required to simulate the structural response of selected penetrations/closures to BDB loadings and to apply this methodology to representative penetrations/closures. Section II discusses a detailed study conducted to determine the structural response of an equipment hatch for a PWR with a steel containment vessel. The macrodeformations of the gasketed joint were computed and then used in a leakage analysis. In Section III, the methodology used to assess the structural integrity of a BWR Mark II containment head is presented. Section IV describes the approach used to obtain upper and lower bounds for the maximum allowable internal pressure and deflection for a representative bellows connection.

23867 (NUREG/CR—4090) **Evaluation of nuclear facility decommissioning projects. Annual summary report, fiscal year 1984.** Miller, R.L.; Baumann, B.L.; Doerge, D.H. (UNC Nuclear Industries, Inc., Richland, WA (USA)). Jan 1985. 122p. NTIS, PC A06 - GPO $5.00. File Number DE85900604.

This document summarizes work performed during the 1984 fiscal year for the Nuclear Regulatory Commission's Evaluation of Nuclear Facility Decommissioning Projects program. This report describes actual work performed during the reporting period and work planned for the future. Included as an appendix to this report is a draft of the current data from the TMI-2 recovery efforts and Shippingport Atomic Power Station decommissioning.

23868 (NUREG/CR—4109) **TRAC-PF1 analyses of potential pressurized-thermal-shock transients at Calvert Cliffs/Unit 1: a Combustion Engineering PWR.** Spriggs, G.D.; Koenig, J.E.; Smith, R.C. (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 352p. (LA—10321-MS). NTIS, PC A16/MF A01 - GPO; GPO Dep. File Number TI85010227.

Los Alamos National Laboratory participated in a program to assess the risk of a pressurized thermal shock (PTS) to the reactor vessel during a postulated overcooling transient in a pressurized water reactor (PWR). We provided the thermal-hydraulic analyses of three general accident categories: steamline breaks, runaway-feedwater transients, and small-break loss-of-coolant accidents. These postulated accidents included multiple operator and equipment failures. Results were provided to ORNL which plans to determine the probability of vessel failure and accident occurrence for an overall assessment of PTS risk. As specified by ORNL, the postulated overcooling transients were simulated for 7200 s (2 h) after the transient initiation. Our study was performed for a Combustion Engineering (C-E) PWR, Calvert Cliffs/Unit 1, using the Transient Reactor Analysis Code (TRAC-PF1). The analyses identified the phenomena important to the PTS issue. Flow stagnation in all reactor coolant loops, which occurred in one transient, could have severe consequences. We found the results to be very sensitive to the initial conditions of the plant. If the plant was initially at hot-zero power (compared to full power), the decay heat was much less, which made it possible for the same accident initiator to produce significantly lower downcomer temperatures. However, routine operator actions may reduce the consequences of any of these simulated accidents if the prescribed pressure-temperature relationships are followed.

23869 (NUREG/CR—4144) **Importance ranking based on aging considerations of components included in probabilistic risk assessments.** Davis, T.; Shafaghi, A.; Kurth, R.; Leverenz, F. (Battelle Columbus Labs., OH (USA)). Apr 1985. Contract AC06-76RL01830. 66p. (PNL—5389). NTIS, PC A04/MF A01 - GPO $4.50. File Number TI85010128.

This report presents a method for focusing additional research on aging phenomena that affects nuclear power plant components. Specifically, the method ranks components using a risk aging sensitivity measure that describes the change in risk due to changes in component failure rate. Describing the aging phenomena and the resulting time-dependent component failure rate changes is beyond the scope of this study. The applications use average component unavailability equations currently employed in PRAs to calculate the risk aging sensitivity. A more exact calculation is possible by using unavailability equations that include the time-dependent characteristics are not well-known. The risk aging sensitivity measure presented here is, therefore, segregated from these time-dependent effects and addresses only the time-independent portion of aging phenomena. The results identify the component types that show the most potential for risk change due to aging phenomena. Future research on the time-dependent portion of aging phenomena for these component types is needed to completely describe the risk impact due to component aging.

23870 (SAND—85-0884C) **MELCOR accident consequence code system (MACCS).** Alpert, D.J.; Chanin, D.I.; Helton, J.C.; Ostmeyer, R.M.; Ritchie, L.T. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 11p. (CONF-850471—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009712.

From Workshop on methods for assessing the off-site radiological consequences of nuclear accidents; Luxembourg, Luxembourg (15 Apr 1985).

Currently, the usefulness of reactor accident consequence assessments for providing guidance for planning and decision making is limited by the poor definition of uncertainties in predicted results. The MELCOR Accident Consequence Code System has been structured to facilitate performing uncertainty and sensitivity analyses. MACCS incorporates improved modeling capabilities in the treatment of variable or long duration releases, deposition modeling, dosimetry, emergency response, radiological health effects, and economic effects. At this writing (March 1985), the new code system has been completed and is undergoing testing, de-bugging,

etc. Release of the first version of the full MELCOR code system, with associated documentation, is anticipated for the Autumn of 1985.

23871 **(NE-F—9-2T-Rev.(2-85)) Seismic requirements for design of nuclear power plants and nuclear test facilities.** (Oak Ridge National Lab., TN (USA)). Feb 1985. Contract AC05-84OR21400. 189p. Nuclear Standards Managment Center, P.O. Box Y, Oak Ridge, TN 37831. File Number TI85010031.

23872 **(CE-Trans—7660) Atmospheric contamination levels recorded in the reactor containment at Chooz, Fessenheim and Tihange nuclear power stations.** Saglini, J.C. (Central Electricity Generating Board, London (UK)). 1979. Translation source information not available . 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901342.

The various forms of atmospheric contamination in nuclear power plants are discussed. Measurements made with the reactor in operation and the reactor shut down at Fessenheim 1 and at the Franco-Belgian nuclear power stations at Chooz and Tihange are presented. 10 refs., 5 tabs. (ACR)

23873 **(CE-Trans—7946) Investigations for determining the flow pattern in the dead water behind local coolant channel blockages in rod clusters.** Basmer, P.; Kirsch, D.; Schultheiss, G.F. Translated from *Atomwirtschaft ;* 416-417(Aug 1972). 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85901147. DE85901147

The temperature increases behind local coolant channel blockages is important for safety considerations of fast sodium-cooled breeder reactors. Due to the fact that the heat transfer from the area of the fuel element affected by the blockage is not as good, critical situations such as the local boiling of the coolant cannot be immediately disregarded. The extent of temperature increase behind blockages is significantly affected by the flow pattern created. The investigations reported here had the objective of making it possible to obtain qualitative information on the flow pattern behind a local blockage in a rod cluster structure.

25 ENERGY STORAGE

2501 Magnetic

REFER ALSO TO CITATION(S) 24984, 24994

2502 Compressed Gas

REFER ALSO TO CITATION(S) 23607

23874 **(PNL—5091) Summary of selected compressed air energy storage studies.** Allen, R.D.; Doherty, T.J.; Kannberg, L.D. (Pacific Northwest Labs., Richland, WA (USA)). Jan 1985. Contract AC06-76RL01830. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85007510.

A descriptive summarily of research and development in compressed air energy storage technology is presented. Research funded primarily by the Department of Energy is described. Results of studies by other groups and experience at the Huntorf plant in West Germany are included. Feasibility studies performed by General Electric are summarized. The feasibility of air storage in dissolved salt cavities is also demonstrated. (BCS)

2504 Capacitor Banks

23875 (CONF-790622—, pp 351-354) **Application of PFN capacitors in high power systems.** Parker, R.D. (Hughes Aircraft Co., Culver City, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The application of lightweight reliable capacitors in a mobile energy store is discussed. The relationship of system design parameters to capacitor size and life is displayed. Electric fields and weights of a 21 J/lb and a 77 J/lb pulse discharge capacitor design are given. Estimates of future near-tern development are made.

2506 Thermal

23876 **(BFR-R—21-1984) Nordic cooperation regarding seasonal storage of heat energy. NBS (Nordic Building Coordination) seminar, October 5-6, 1983.** Gustavsson, G.; Haard, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 439p. (In Swedish). (CONF-8310376—). NTIS (US Sales Only), PC A19/MF A01. File Number DE85751422.

From Nordic seminar regarding seasonal storage of heat; Goeteborg, Sweden (5 Oct 1983).

A working program for Nordic Cooperation in the energy field was agreed upon by the Nordic ministers for energy in 1982. The Nordic Council of Ministers have, i.a., recommended integrated research into seasonal storage of heat in soil, rock, and water and charged the NBS-Energy and the BFR (Swedish Building Research Council) to conduct a cooperative program. A Nordic Coordination Group (Seasonal Storage Group) was therefore founded with two representatives of each country (Denmark, Finland, Norway and Sweden). Its aim is: - to dissipate information about past research and development projects - to evaluate jointly past projects, - to inform about pilot plant work, - to coordinate research efforts among the participant nations and direct them to fields of common interest. This conference had as its main goal to increase knowledge about on-going research and to exchange experience. The main topics of the short papers were: - the significance of storage for the public, - general problems, - technology, - development.

23877 **(BFR-R—22-1984) Heat storage in bog soils. Technique - economy - ecology - potential.** Andersson, O.; Friman, M.; Kihlbom, V.; Linder, U. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 69p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751438.

Out of approximately 5.4 million ha moss and bog areas of Sweden more than 3 million have sufficient depth for large scale heat storage. Of practical interest are bogs covered with insulating layers of low humus containing white moss with high heat capacity containing 80-90 percent water. About 2-4 MJ/m^3 degreeC could be stored at such sites. Because of its low heat conductance a high temperature gradient towards heat exchange medium and a low water table are required together with low water penetration ability. Two solutions have been studied: One: Conductive heat exchange with plastic tubes placed with tightly packed tube loops into the soft peat surface. At a temperature of 40 degreeC a coefficient of efficiency of 70-80 percent for 1 MW energy storage is expected. Two: Water-borne convective heat exchange from circulating bog water through horizontal pits at calculated 5 1/s per ha area, similar to established methane production. Both methods are cost attractive, calculated specific investment being between 700 and 900 SEK/kW extracted. For a large system a specific storage cost after 6 months storage is appr. 0.20 SEK/kWh. Theoretically, about 3000 TWh can be stored and more than 2000 TWh could be retrieved. Several factors reduce the potential: e.g. the necessity of locations near settlements or industrial users. Only 15 percent of suitable areas are inside 5 km and 5 percent inside 2 km radius. Heat storage in bog areas is expected to result in increased decomposition of peat and increased methane bacteria activity and still unknown effects on fauna and flora in affected areas which still have to be elucidated by experiments.

23878 **(BFR-R—115-1984) Short time heat storage in water. Technique and economics of minor systems.** Hallenberg, J.; Knutsson, R. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 35p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751470.

Water heaters comprise the most common method for small houses or blocks for heating purpose. The technique and economy has been studied using a technical model characterized by energy

requirements, loading and unloading times, operating temperatures, etc and an economical model which allows the cheapest system and combination of different energy sources and operating modes to be chosen depending on both on investment costs and tariff price structures obtaining now and the near future. For quick and rough estimates of accumulator requirements and boiler sizes as function of annual oil consumption a diagram is presented. Accumulators of various type as well as circuit diagrams are described and suppliers named in a separate list.

23879 **(BFR-R—130-1984) Heat storage in a two story rock cavern. Preliminary study.** Gustafson, G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 55p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751450.

The possibilities to construct large heat stores in rock caverns are investigated. The proposed technology makes use of an increased contact between the rock and the heat carrier by connecting two caverns vertically through a number of boreholes. The study indicates that the concept should be feasible although it will differ from conventional caverns in some ways. A economic appraisal of the system indicates it to be some 25 percent cheaper than a conventional rock cavern heat store.

23880 **(LiTH-IKP-R—252) Short term heat storage. Possibilities and limits of industrial applications.** Johansson, T.; Soederstroem, M. (Linkoeping Inst. of Tech. (Sweden). Dept. of Mechanical Engineering). Jun 1982. 122p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85751455.

The industrial use of energy is characterized by different types of effect level variations. The chances of damping the variations by energy storage have been investigated. They depend on the following presumptions: - time shifting between various processes - supply of surplus energy - adequate potential levels. The demand has been investigated branch by branch. A number of heat sources and heat sinks are presented. Some energy transfer couplings are of interest: air/air, air/water, water/air and water/water. Applications are described from bakery and cooking, use of heat from cooling water in plastic industry and storage of high temperature energy from heat treatment. The total potential of energy conservation by short term storage is estimated to 5050 GWh for the investigated branches.

23881 **(N—85-15524) Thermodynamical characteristics of heat storage reactors using metal hydrides.** Endo, H.; Ito, T.; Wakao, S. (National Aerospace Lab., Chofu, Tokyo (Japan)). Jul 1984. 24p. (NAL-TR—822). NTIS, PC A02/MF A01.

Theoretical and experimental investigations of a metal hydride heat storage system are presented. Two types of model reactors, one with quasi-two-dimensional and the other with axisymmetric filling of metal hydride, were constructed. The reaction and heat transfer processes were constructed. The reaction and heat transfer processes were analyzed both theoretically and experimentally, and based on the results, the characteristic quantities which influence the performance of reactors were formulated. Then, design criteria for good performance were put forth in terms of these quantities.

23882 **(ORNL/TM—9432) Thermal Energy Storage Program. Annual operating plan FY 1985.** Martin, J.F.; Carbajo, J.J.; Olszewski, M.; Tomlinson, J.J. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85008745.

The Thermal Energy Storage (TES) program operating plan for FY 1985 is presented. The overall program goal, program objectives, specific program elements, and program implementation plans are defined. The overall work breakdown structure is shown, and specific elements of the program that will be pursued in FY 1985 are defined. The objectives, rationale for inclusion in the program financial budgets, and milestones for each element are given. The Oak Ridge National Laboratory TES program management plan is presented.

2509 Batteries

23883 **(N—84-20759) Performance of alkaline battery cells used in emergency locator transmitters.** Haynes, G.A.; Sokol, S.; Motley, W.R. III; McClelland, E.L. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Mar 1984. 59p. (NASA-TP—2277). NTIS, PC A04/MF A01. File Number DE85900884.

The characteristics of battery power supplies for emergency locator transmitters (ELT's) were investigated by testing alkaline zinc/manganese dioxide cells of the type typically used in ELT's. Cells from four manufacturers were tested. The cells were subjected to simulated environmental and load conditions representative of those required for survival and operation. The objective of the study was to evaluate battery cell characteristics that may contribute to ELT malfunctions and limitations. Experimental results from the battery cell study are discussed, and an evaluation of ELT performance while operating under a representative worst-case environmental condition is presented.

23884 **(UCID—20307) Aluminum-air power cell: the M3-3 experiment.** Maimoni, A.; Muelder, S.A. (Lawrence Livermore National Lab., CA (USA)). 1 Mar 1985. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008878.

The M3-3 experiment was a test of the M3 cell coupled to a crystallizer and hydrocyclone for separation of coarse solids before return of electrolyte to the cell. It was essentially a repeat of the M3-2 experiment, but with increased emphasis to understand the sources of experimental error and the evolution of the particle size distributions during the course of the experiment. A new hydrocyclone, scaled to operation with 1 to 5 cells, was tested in conjunction with peristaltic pumps. The test ran at 14 A for 101 min, followed by 122 A for 269 min at 60°C. The main operational problem was failure of the rubber tubing in the peristaltic pump feeding the hydrocyclone. Primary results include reasonable agreement in the material balances and with the calculated crystallization rates, the 50% cut point of the new hydrocyclone at about 8 μm, and the aluminate concentration decreased from 2.4M to 1.4M in 21 h at 60°C in a subsequent batch crystallization experiment. The particle size distributions do not change significantly on aging de-ionized water. It is recommended that electrolyte conductivity should not be used as the only measure of aluminate concentration. More care is required to obtain meaningful samples of suspension from crystallizer vessels. Insufficient stirring in the vessels led to settling of the solids and obtaining non-representative samples.

23885 **Lithium aluminum/iron sulfide battery having lithium aluminum and silicon as negative electrode.** Gilbert, M.; Kaun, Th. D. (to The United States of America as represented by the United States Department of Energy). US Patent 4,489,143. 18 Dec 1984. Filed date 20 Jan 1984. vp. PAT-APPL-572345.

A method of making a negative electrode, the electrode made thereby and a secondary electrochemical cell using the electrode. Silicon powder is mixed with powdered electroactive material, such as the lithium-aluminum eutectic, to provide an improved electrode and cell.

29 ENERGY PLANNING AND POLICY

23886 **(CONF-8310378—) What Energy.** Nordin, T.; Lundberg, A.S.; Norrstroem, A. (Linkoeping Univ. (Sweden)). 1983. 486p. (In Swedish). NTIS, (US Sales Only), PC A21/MF A01. File Number DE85751430.

From Symposium on energy technology for policy makers; Linkoeping, Sweden (17 Oct 1983).

This survey is addressing to the leaders engaged with energy problems. The oil crisis gave birth to a purposeful national energy program and to a number of actions in the commercial life of Sweden. The communes have got important tasks and they have taken the responsibility of the development by the decision - making of municipal energy planning. Different specialists are pre-

senting their views in this publication together with panel discussions. The conditions of the time are considered without shadowing the future problems.

2901 Energy Analysis And Modeling

23887 (ESC—29) The EZ-reference scenario 1984. Some calculations using the energy model SELPE. Boonekamp, P.G.M.; Bruggink, J.J.C. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Dec 1984. 121p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The Dutch Ministry of Economic Affairs has asked the Energy Study Centre (ESC) for support in constructing a reference energy scenario 1984. This scenario is an update of the scenario set up in 1981 for the National Public Inquiry on Energy (MDE). On the basis of final energy demand projections from the Central Planning Bureau and assumptions about the development of energy technologies and prices computations were done with the energy supply model SELPE to construct optimal energy balances for the years 1990 and 2000 including several variations of the base case. Because of the present public discussion on new power stations for the 1990's special attention has been given to developments in the electricity sector, in particular with respect to reliability and other technical aspects. The latter part has been done in cooperation with the State University Utrecht. The national energy model SELPE which has been respecified and adopted for this study is shortly described. The most important inputs are briefly discussed. The global results including financial and environmental implications are presented. The developments in the electricity sector are presented separately. (J.C.R.)

23888 (ESC-WR—85-01) Extension and respecification of the energy model SELPE for the calculations for the EZ-Reference scenario 1984. Boonekamp, P.G.M. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Jan 1985. 209p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The energy model SELPE has been extended with 7 energy consumption sectors. Furthermore the energy consumption patterns of the end users have been modelled more in detail. For each end user the energy demand is modelled for electricity, steam/hot water and other process heat. In the industrial sector the energy conversion apparatus has been introduced. The new energy model is described in detail. (J.C.R.)

23889 (EUR—9170-EN) EFOM-12C/GRESOM-6: A model for the Greek energy system. Samouilidis, J.E.; Arabatzi-Ladia, A.; Constantinidou, K.; Despotakis, K.; Psarras, J.; Sahinis, H.; Themelis, G.; Varlas, N. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 120p. Commission of the European Communities, Luxembourg.

The EFOM-12C/GRESOM-6 model for the Greek energy system employs the software of the EEC's Energy Flow Optimization Model (EFOM-12C) and the subsystems description of the Energy Policy Unit's (NTUA) Greek Energy System Optimization Model (GRESOM-6). The aim of the model is not the forecast of the energy future but rather the analysis and evaluation of a variety of alternative scenarios for the evolution of the Greek energy system up to the year 2020. Thus the model could be a valuable and reliable analytical tool in the hands of energy policy makers. Results of four alternative scenarios and the 'Escalating Supply Rationing' case study are presented.

23890 (EUR—9178-EN) Research activity carried out by the Prometeia Group (Italy) for the HERMES macrosectoral model. Bosi, P.; Stagni, A.; Bidoia, L.; Golinelli, R. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 124p. Commission of the European Communities, Luxembourg.

Part one reports on the strategy followed in the construction of two data bases: (1) the general data bank (completed in 1982, already described in the second intermediate report of Sept. 1982, and sent to the Commission); (2) the energy data base, only recently completed, which will be sent to the Central Group. Part two describes the results achieved in the research developed on the production block. Estimates of alternative specifications of the production functions are presented, as well as the tests performed on the anticipations and scrapping mechanisms. The section also includes a comparison of the different results and a suggested interpretation of Allen and price elasticities. Part three illustrates the outcomes of the research performed on the energy block. Estimation results of energy input demands equations and comments on the Allen and price elasticities are presented.

23891 (EUR—9238-EN) Energy conservation on exposed domestic sites. O'Farrell, F.; Lyons, G.; Lynskey, G. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 249p. Commission of the European Communities, Luxembourg.

The internal heat gains from solar radiation in two unoccupied isolated houses resulting from external climatic factors were recorded over a two year period at Oakpark Research Centre, Carlow, Ireland. Different recording regimes were undertaken with altered site characteristics mostly windbreaks. Using the monitored data, regression models for each regime were generated which related internal ambient temperature to the external climatic parameters. A model was developed to withstand the difficulties imposed by short monitoring periods and these regression models were used to predict internal temperatures for a standard reference year. Thus resulting energy saving for different site characteristics were estimated. The savings due to the erection of a windbreak were in the region of 5% to 10% and the savings accruing from the use of a standard low energy house was about 70% over a basic house. The possible implications of these savings for Ireland and Europe are outlined.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 23512, 23922, 23924, 23930

23892 Location, agricultural risk, and farm-income diversification. Jones, D.W. (Oak Ridge National Lab., TN). *Geographical Analysis;* **15**: No. 3, 231-246(Jul 1983).

Prices of agricultural products are notoriously subject to sizable, but unpredictable, annual fluctuations. Farm incomes consequently have a similar year-to-year instability. In the absence of government insurance or stabilization programs, farmers are left to themselves to devise methods of reducing fluctuations in their incomes to acceptable levels. Among their options are crop diversification, allocation of their labor between farm and nonfarm employment, and tenure contracts. It is well known from the Thuenen model that land rent and consequently farm income decrease with distance from markets. The author shows that it also predicts increasingly risky farm incomes over the same distance. Motivated by and equipped with these conclusions, he investigates the possibility that farmers at different distances from market organize their activities and the resources at their disposal differently, because of the differences conferred by location. He examines the models predictions with American data from 1880. 12 references, 4 figures, 1 table.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 23483, 23494, 23495, 23496, 23899, 23901, 23922, 24292, 24329, 24425, 24428, 24469, 25084, 25085, 25088, 25089

23893 (ANL/EES-TM—272) Evaluation of opportunities for effluent trading in the steam-electric, petroleum-refining, and coal mining industries. Davis, M.J. (Argonne National Lab., IL (USA)). Oct 1983. Contract W-31-109-ENG-38. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009771.

This study examined the opportunities for energy industries (steam-electric, petroleum refining, and coal mining) to use various effluent trading options. The study was based on an examination of

the options applicable to these industries and on an extensive inventory of energy facilities with water-quality-based conditions in their discharge permits. The results obtained tend to overstate any opportunities available. The most viable candidates for interplant trading are petroleum refineries with water-quality-based limits on BOD. Point/nonpoint source trading involving coal mines (or possibly other energy facilities) might be profitable at some future time if permit limits that require TDS removal are imposed on facilities in the arid west. No attractive opportunities for intraplant training are available. Other conclusions are as follows: There appear to be no widespread opportunities available for effluent trading involving multiple energy facilities. Localized opportunities may exist in Louisiana and Texas, where there are small groups of petroleum refineries with water-quality-based permit limits. For interplant trading to be feasible the participation of nonenergy facilities will be necessary. However, opportunities for trading with nonenergy facilities appear to be limited. Seasonal or variable permits appear to be a more attractive and more easily implementable means for cost-effective pollution control for energy industries than does effluent trading, since each facility can use such an approach independently of the presence of any other compatible trading partners. The viability of interplant trading is dependent on a concentration of compatible dischargers, with at least some having water-quality-based permit limits on the same, appropiate pollutants. The lack of such concentrations limits the utility of the concept for energy industries. 21 refs., 1 fig., 5 tabs.

23894 (BNL—51779, pp I.5-I.19) **Issues in the development of California's Carcinogen Control Policy.** Hooper, K. (California Dept. of Health Services, Berkeley). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

In a process that is unique to state government, the California Department of Health Services has been formulating a carcinogen policy for the past two years. Our policy focuses on the risks of exposure to chemical carcinogens; however, the principles discussed apply equally well to other major causes of cancer (e.g., cigarette smoke, radiation, viruses). In an attempt to separate science from policy, the California Carcinogen Policy has been developed in three sections: (1) carcinogen identification; (2) risk assessment; and (3) policy considerations. A carcinogen policy must make decisions on a number of controversial issues. In most cases, we have selected those options which we believe to be scientifically reasonable and consistent with a prudent public health policy. While our policy follows precepts set forth in the earlier Inter-Agency Regulatory Liaison group (IRLG) and Occupational Safety and Health Administration (OSHA) cancer policies, important differences exist which are discussed: (1) a positive result from a single, well-conducted animal bioassay defines the universe of carcinogens; (2) chemicals for which expert committees (e.g., International Agency for Research on Cancer or National Toxicology Program) have deemed there is sufficient evidence for carcinogenicity will be considered actionable carcinogens; and (3) risks are estimated for carcinogens without regard to their mechanisms of action. 1 table.

23895 (BNL—51779, pp V.14-V.27) **Are we ready to apply the de minimis concept to standard setting: a historical approach.** Stannard, J.N. (Univ. of California, San Diego). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

The pros and cons of the de minimis concept is discussed from a historical point of view. The purpose is first to indicate how long ago many common occupational hazards were recognized and second to conclude that there had to be exposure levels that were essentially trivial, i.e., de minimis. Some aspects of the history of radiation protection are presented. The topics of discussion include: empiricism; the tolerance dose; the maximum permissible exposure dose; as low as possible dose (ALAP) and as low as reasonable achievable (ALARA); and the challenge of the '80s. In the '80s with the strong movement to use risk as a basis for both radiation and chemical standards, the need for adding the concept of a trivial risk has taken hold. Some examples of possible de minimis levels, as well as some of the problems and current activities, are presented.

23896 (BNL—51779, pp V.28-V.33) **Policy issues in setting de minimis standards for latent cancer risks of radiation and chemical carcinogens.** Spangler, M. (Nuclear Regulatory Commission, Washington, DC). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

In the fuel cycles for the development and utilization of alternative energy resources, the risk of latent cancer arises from a number of sources. Included are ionizing radiation and the carcinogenic potential of polluting chemicals present in certain fuels or in materials associated with the construction, operation, maintenance or waste treatment processes of nuclear power, fossil fuels, synfuels, biomass, and other sources of energy. One aspect of developing a carcinogen guideline policy for a consistent and effective regulatory regime to use in dealing with these assorted carcinogenic risks is the setting of de minimis quantitative standards. In this report, 11 policy issues related to the setting of such regulatory standards are identified and a brief commentary is provided. 15 references, 1 table.

23897 (BNL—51779, pp VI.2-VI.19) **Regulatory policy propositions.** Davis, D. (Environmental Law Institute, Washington, DC). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

An attempt is made to evaluate some of the laws requiring risk assessment that regulate toxic substances in the environment. In some cases the laws consider health only. The Toxic Substance Control Act stipulates that things can be regulated if they cause cacinogenic, mutagenic, teratogenic, behavioral, or other synergistic effects. Suggested propositions for consensus include: animal studies versus human studies; threshold and linearity for chemicals, including population susceptibility; exposure to multiple low-dose carcinogens and mixtures of toxin; limits of cost-benefit analysis; scientific regulation of carcinogens; cancer policies including identifying carcinogens; and regulation decision making as to risk.

23898 (CONF-8406246—) **Environmental management needs. Final report, September 19, 1983-December 31, 1984.** (Woodrow Wilson International Center for Scholars, Washington, DC (USA)). 31 Dec 1984. Contract FG01-83EP16032. 674p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85007859.

From Conference on the evolution of American environmental politics; Washington, DC, USA (28 Jun 1984).

The conference examined, in historical perspective, the origins, evolution, and current circumstances of some of the most important institutions and public policies at the national level in the field of environmental affairs. Selected topics in both the regulatory area and in the area of preservation and management of resources were covered. Presented papers have been individually abstracted for inclusion in the data base. (ACR)

2904 Natural Resources

REFER ALSO TO CITATION(S) 23898, 24464

23899 (CONF-830669—, pp 97-102) **Assessment of climate information to serve the energy industry in Colorado.** McKee, T.B.; Doesken, N.J. (Colorado State Univ., Fort Collins). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

State climate centers have emerged in the US following the termination of a federal program in 1973. The Colorado Climate Center has been involved with research and information services for the energy industry for several years. Application of climate information to reclamation of mined lands is described with examples of new uses of information. Examples are given of the role of a state climate center in the dissemination of climate information, such as heating degree days, winter design temperatures, and solar radiation data. Services available at the state center are outlined. A

set of climate data that outlines both the elements and the time and space scales required to meet the needs of the energy industry is presented.

23900 **(GAO/RCED—85-17) Potential impacts of tighter Forest Service log export restrictions.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 28 Jan 1985. 45p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877. File Number TI85901365.

Federal law restricts the export of unprocessed timber cut from national forests in the western half of the United States. Also, purchasers of national forest timber are restricted from substituting timber harvested from federal lands for privately owned timber that they export. GAO reviewed the magnitude of and the potential impacts from extending the substitution restriction to cover third parties who subsequently acquire Forest Service timber from the original purchasers - an export industry practice commonly referred to as third-party substitution. According to the Forest Service and timber industry associations, third-party substitution approximates 100 million board feet annually in the western United States. They said that if the practice were banned, some companies could acquire national forest timber at lower prices because of decreased demand and competition, and the lower prices would result in less government revenues. Also, a ban could disrupt traditional log markets and business practices. The Forest Service believes it could not enforce a ban on third-party substitution without additional legal authority and staff.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 23608, 23933, 24465

23901 **(DOE/BP—391) Analysis and development of a project evaluation process.** Coutant, C.C.; Cada, G.F. (Oak Ridge National Lab., TN (USA)). Feb 1985. Contract AC05-84OR21400;AI79-84BP19349. 152p. NTIS, PC A08/MF A01; GPO Dep. File Number DE85009855.

The Bonneville Power Administration has responsibility, assigned by the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501; 16 USC 839), for implementing the Columbia River Basin Fish and Wildlife Program of the Northwest Power Planning Council. One aspect of this responsibility is evaluation of project proposals and ongoing and completed projects. This report recommends formalized procedures for conducting this work in an accurate, professional, and widely respected manner. Recommendations and justifications are based largely on interviews with federal and state agencies and Indian tribes in the Northwest and nationally. Organizations were selected that have evaluation systems of their own, interact with the Fish and Wildlife Program, or have similar objectives or obligations. Perspective on aspects to be considered were obtained from the social science of evaluation planning. Examples of procedures and quantitative criteria are proposed. 1 figure, 2 tables.

23902 **(DOE/CE—0023/4) Comprehensive Program and Plan for Federal Energy Education, Extension and Information Activities: annual revisions.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC; Meridian Corp., Falls Church, VA (USA)). Jan 1985. Contract AC01-83CE30784. 116p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85010970.

Eighth report to Congress.

This report is the annual revision to the Comprehensive Program and Plan for Federal Energy Education, Extension and Information Activities pursuant to Section 508 of the National Energy Extension Service Act, 42 U.S.C. 7007. It is also the report required under Section 404 of the Energy Security Act, 42 U.S.C. 7373. The report draws together in summary fashion the many current federal energy education, extension and information efforts. The programs cover a range of energy applications and address many different and mutually exclusive audiences through an array of delivery mechanisms, including volunteer efforts, R and D initiatives and intensively managed efforts aimed at specific audiences. This report reflects the coordination efforts between and among federal agencies, states, local communities and private groups in carrying out these energy programs.

23903 **(DOE/ER/10052—T1) Technology characterization project summary report.** (OAO Corp., Beltsville, MD (USA)). Nov 1979. Contract AC01-79ER10052. 355p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85010311.

This project resulted from the desire of selected DOE management and technical staff to institutionalize the development, collection, and maintenance of technical information needed for preparation of RD and D strategies, analysis of budget priorities, communications outside the Department, and development of the Department's annual reports. Technology characterization was defined as including: a set of standardized procedures for developing a quantitative description of technology, process or conservation option, an estimate of future energy project costs and the uncertainty associated with these estimates, and an estimate of the funding required to develop the technologies described; an official DOE data file containing the characterization information; and a process for developing and updating both the procedures and the data files. The technology characterization project is aimed at meeting the analytic needs of the planning, programming, and budgeting process.

23904 **(DOE/ER/10167—T1) Final report: National Commission on Research.** (National Commission on Research, Washington, DC (USA)). Feb 1982. Contract FG01-80ER10167. 185p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85008107.

The National Commission on Research was a private, nonprofit organization established to examine the relationships between government agencies and universities involved in research and to develop specific recommendations for improvements. The Commission worked independently of its founders to examine the process by which the federal government supports academic research and to propose changes designed to improve that process. Subcommittees of the Commission investigated the following issues: accountability; peer review and other selection processes; alternative funding mechanisms; industry/university/government relationships; and development of research personnel. Position papers on these five topics were published by the Commission and are included in this report.

23905 **(INIS-mf—9446) Department of Atomic Energy: Annual report, 1983-1984.** (Department of Atomic Energy, Bombay (India)). 1984. 59p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780868.

The annual report of the Department of Atomic Energy for the financial year 1983-84 describes its activities under the headings: Nuclear Power, Research and Development, Public Sector Undertakings, and Other Activities. The report surveys: (1) the performance of nuclear power plants at Tarapur, Kota and Kalpakkam, heavy water plants, fuel fabrication and reprocessing plants, and waste management facilities, (2) the research and development activities of Bhabha Atomic Research Centre at Bombay and its constituent units at various locations in the country, Reactor Research Centre at Kalpakkam, the aided institutes, namely, Tata Institute of Fundamental Research and Tata Memorial Centre, both at Bombay, and Saha Institute of Nuclear Physics at Calcutta, (3) performance of public sector undertakings: Indian Rare Earths Ltd., Uranium Corporation of India Ltd., and Electronics Corporation of India Ltd., (4) progress of nuclear power projects at Narora and Kakrapar, Orissa Sand Complex Project, MHD project at Tiruchirapalli, DHRUVA (formerly known as R-5) project at Bombay, Fast Breeder Test Reactor and 500 MW Prototype Fast Breeder Reactor projects at Kalpakkam, and heavy water projects at Thal-Vaishet and Manuguru, and (5) other activities including technology transfer; training; service to industry, agriculture and medicine in use of radioisotopes and radiation, export of radioisotopes, allied products and nuclear instruments; international relations; country-wide radiation safety programme, exploration of atomic minerals; information and publicity etc. An Atomic Energy Regulatory Board was established during the report year for the special pur-

pose of carrying out regulatory and safety functions specified in the Atomic Energy Act of the Government of India.

23906 R & D for post-crisis energy security. Kerr, D.M.; Willis, E.H. (Los Alamos National Lab., NM). *Energy Exploration and Exploitation;* 3: No. 2, 127-137(1985). Contract W-7405-ENG-36.

Present perceptions of the energy situation for the foreseeable future are substantially different from those of the mid-1970s when major energy R & D programs were undertaken in response to the first oil shock of 1973. R & D objectives must reflect the changing energy and economic environment. They must, by definition, be addressed to the long term, but they cannot ignore pressing current concerns such as the mitigation of environmental impacts caused by energy use. They must also be predicated upon recognizable and accepted criteria, and be relevant to the needs of individual country circumstances. It is increasingly apparent, however, that national energy R & D programs can be significantly enhanced by international collaboration in certain areas, particularly those where impacts will only be felt in the longer term. More specifically, international collaboration can present distinct advantages for energy R & D by: (1) reducing the technical and economic risk to each participant; (2) increasing the efficiency within individual national budgets, perhaps making possible otherwise unaffordable area of research; (3) limiting duplication and allowing more to be done with total resources available; (4) permitting a wider range of intellectual approaches and optimal use of available scientific talent and accelerating the pace at which greater results are achieved; and (5) making possible progress in technologies where next step costs might preclude proceeding at all on a national level. 5 references, 3 tables.

23907 Federal organization for technological innovation. Hearings before the Subcommittee on Science, Research and Technology of the Committee on Science and Technology, House of Representatives, Ninety-Eighth Congress, Second Sesssion, June 7, 12, 13, 14, 1984. Washington, DC; Government Printing Office (1985). 575p.

Four days of hearings were devoted to the idea of reorganizing the federal involvement in technological innovation. Proposals to establish a new foundation that would either create or coordinate existing programs are aimed at bringing new technology to the point of commercialization. Other proposals would explore industrial competitiveness to see if there is a consensus for federal involvement. Among the witnesses were administration advisors, university professors, and representatives of several high-technology industries and government agencies. The testimony centered on several bills dealing with robotics as well as with the formation of a foundation. An appendix with additional material submitted for the record follows the testimony of 17 witnesses.

23908 Fiscal year 1985 Department of Energy Authorization (support research and technical analysis). Volume VII-B. Hearing before the Subcommittee on Energy Development and Applications of the Committee on Science and Technology, US House of Representatives, Ninety-Eighth Congress, Second Session, February 23, 1984. Washington, DC; Government Printing Office (1985). 1695p.

Volume VII-B covers two appendices with material supporting the testimony given on research and technical analysis budgets. Appendix I continues questions and answers submitted for the record by Alvin W. Trivelpiece and material on research programs at various laboratories, research institutes, and universities. Appendix II contains eight background reports, a statement by the Association of American Universities, and the DOE budget request for research programs. The budget includes a program overview and budget breakdowns for the following programs: Basic Energy Sciences, Energy Research Analysis, University Research Support, University Research Instrumentation, Advisory and Oversight Program Direction, and Multiprogram General Purpose Facilities.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 23516, 23541, 23544, 23551, 23804, 23898, 23905, 24329

23909 Breaking the nuclear deadlock: defense-protected build-down. Barkenbus, J.N.; Weinberg, A.M. (Oak Ridge Associated Univ., TN). *New Scientist;* 40: No. 8, 18-23(Oct 1984).

In describing their defense-protected build-down the authors assume the following: (1) The arms race has spiraled upward because neither the United States nor the Soviet Union will accept being at a strategic disadvantage vis-a-vis its adversary. (2) Stable deterrence is possible, and desirable, at much lower force levels than are not deployed, and with opposing forces roughly at parity. (3) Traditional arms-control efforts and bilateral negotiations show little promise of producing much lower force levels. (4) Unilateral American disarmament is politically impossible at present. Of these propositions, perhaps the last - the political infeasibility of unilateral disarmament - is the most controversial. If stable deterrence can operate at a lower force level, one might ask, why not simply reduce our offense in the expectation that such an act of US statesmanship would lead to a corresponding reduction by the Soviets? Yet, given today's political realities, no US president could order a serious reduction, even in superfluous elements of the strategic nuclear force, without an equivalent and verifiable reduction by the other side. The possibility of anti-missile defense, even a relatively poor defense, would make such a unilateral build-down much more feasible, the authors feel.

2907 Transport And Storage

23910 (STEV-TFS—84-5) Basic data for transport systems for domestic fuels. Colliander, J.; Carlsson, V.; Plass, E.; Lindeborg, Y. (Statens Energiverk, Stockholm (Sweden)). Apr 1983. 152p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85751415.

The part of this report contains an account of the geographic distribution of the supplies and demands for solid domestic fuels (peat, wood fuels and straw) in Sweden. The second part describes available, and coming, technology for handling and transport of these solid fuels. The aver-all aim of the project was to create a basis for planning the transport sector on a national, regional and local level.(L.E.).

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 23936

23911 (EPRI-EM—3943) 1983 utility cogeneration survey. Final report. Farber, M.J.; Limaye, D.R. (Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Apr 1985. 83p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. File Number TI85920582.

In response to an increased interest in cogeneration, utilities have initiated a number of programs and activities related to cogeneration. The Electric Power Research Institute (EPRI) sponsored this survey to collect, organize and disseminate information regarding the major utility programs and activities. The survey gathered information on cogeneration activities from 54 utilities across the United States. Data was obtained on: the inventory of cogenerators in the service areas, utility programs and activities, tariffs and rates, terms and agreements related to standard offers and negotiated agreements, regulatory matters, and procedures for interconnection, dispatch and control. A total of 548 cogenerators, with 11,062 MW of capacity, exist in the service area of the 54 surveyed utilities. All utilities provide some type of technical assistance to cogenerators, including feasibility studies, seminars and workshops, promotional campaigns, economic incentives and direct participation in cogeneration ventures. Assessments of cogeneration potential in their service area have been performed by 33 utilities. Standard offers for small (15 kW to 1 MW) cogeneration facilities have been developed by 33 of the surveyed utilities. Energy credits offered to cogenera-

tors have been published by most of the utilities. A total of 27 utilities offer or are willing to negotiate capacity credits for firm power. Regulatory commission requirements for standard offers and for filing and approval of negotiated agreements and rates, also vary considerably from state to state, ranging from no filing/approval requirements to requirements for filing and approval of all agreements and rates. Most utilities surveyed have established some guidelines and procedures for interconnection of cogenerators to the utility system.

2910 Conservation

REFER ALSO TO CITATION(S) 23976, 23994

23912 (ESC-WR—85-06) Investment in energy saving; an inquiry into the role of the Dutch industry as supplier. Van Wees, F.G.H.; Boswinkel, H.H.; Duijves, K.A.; Gerbers, D.; Kruijswijk, B.J.; Van der Veen, J.C. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Feb 1985. 600p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

The possible role of the Dutch industry as supplier for energy conservation techniques is discussed. Main topics are: district heating, coal utilization, heat pumps, waste heat recovery, wind- and solar energy, combined heat-power systems, incineration and digestion of organic wastes, etc. Possibilities for further investigations are mentioned. For each topic some case studies are given in a separate volume (ESC-WR--85-06B). (A.V.)

23913 (ESC-WR—85-09) Energy saving by the consumers: the efficiency of some political instruments. Midden, C.J.H. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Mar 1985. 36p. (In Dutch). ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Energy conservation can be affected by technical improvement and by changing the human behavior. The human behavior is strongly influenced by the social and cultural environment, education and income class. To explain human behavior one can make use of the attitude-behavior models, based on known or supposed behavior of human beings, as their own thoughts (what do I think of it), social considerations (what do others think of it), habits (not always rational), and sometimes skill (thermal insulation of dwellings is not done by awkward people). Energy saving behavior can also be influenced by economic factors (loans, subsidies and premiums), sufficient information and a sensible energy policy. A frequently executed feedback is necessary for control and checking. (A.V.)

23914 (EUR—9269-EN) Energy saving in the commercial catering market. Enga, T.G. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 89p. Commission of the European Communities, Luxembourg.

The cost of cooking a meal comprises food costs, labour charges, overheads and energy costs, the last item being a very small part of total costs. However, significant savings in energy consumption can be easily made using existing designs. Watson House has carried out a study, co-funded by the Commission of the European Economic Communities, into ways of saving energy in commercial catering. Areas of appliance design, control and usage have been investigated and the potential for waste heat recovery from kitchens assessed. The catering gas consumption could be reduced by 3% if all gas catering appliances were optimised. A further 2% saving could be made by adopting the best currently available designs. Improvements in kitchen management and appliance usage could reduce consumption by another 5% and waste heat recovery, equivalent to 3% of gas consumption, is feasible for larger kitchens in hotels, restaurants, canteens and institutions. The potential benefits of this study amount to gas savings of 6500 TJ for the UK and 31,000 TJ for the EEC or over 12% of catering gas consumption if all the findings could be implemented.

23915 (LBL—19126) State survey of innovative energy programs and projects. Vine, E.L. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 49p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010635.

This paper presents the results of a survey of innovative energy programs and ideas in nineteen states outside California. Energy conservation and renewable energy programs were examined in the residential sector, small business, public buildings, local government, schools, transportation, and agriculture. Energy data management systms, and energy information, education, and financing programs were also reviewed.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 23493, 23906, 23920, 23988

23916 (BFR-R—43-1984) Energy supply program foe Esloev. Local energy sources versus natural gas. Toernqvist, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 82p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751464.

The government decided to introduce natural gas in western Scania in order to reduce dependence on oil. The BFR supported an investigation because of the general applicability of the findings for the region. Heating energy now mostly based on oil and industrial process energy could be supplied by natural gas, or locally from peat, or wastes from industrial and civic sources. Following a stock taking of local energy supply plant and distribution systems for 1980-82 a comparison of economic, technical, environmental, reliability and flexibility parameters was carried out taking regard to requirements and developments up to 1990 concerning energy savings. For natural gas the cost was estimated in absence of firm market price figures and the effect of uncertainties demonstrated by a sensitivity analysis. The district heating alternative must be limited to densely populated central areas on economic grounds. Heat pump generated energy and burning of peat are price comparable but use of peat is undesirable from other considerations. Natural gas is well suited for heating and process purposes though not in areas already supplied by electricity. Mixed systems for district heating and natural gas have advantages.

23917 (DOE/EIA—0384(84)) Annual Energy Review 1984. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Apr 1985. 264p. NTIS, PC A12/MF A01 - GPO; GPO Dep. File Number DE85010696.

Statistics of US energy production, consumption, supply, disposition, and prices are provided for each year from 1949 through 1984. Some international data are also included. The report is divided into 10 sections which cover the following topics: energy supply and disposition overview; energy supply and disposition - indicators; energy resources, exploration and development, and reserves; supply and disposition of petroleum, natural gas, coal, electricity and nuclear energy; wood, solar and geothermal energy; and international energy data. A narrative discussion precedes each section. A glossary, explanatory notes, units of measure, conversion factors, price deflators, and energy equivalents are included. Appendix 1 provides a map of US census regions. 105 figs., 105 tabs.

23918 (DOE/EIA—M006) Documentation of the Demand Analysis System database. Holte, J. (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). Apr 1985. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011523.

The Demand Analysis System (DAS) database provides the fuel definitions for the demand models of DAS which are used for the demand side representation of the Intermediate Future Forecasting System (IFFS). The DAS database described in this report was used in the preparation of the Annual Energy Outlook 1984, (AEO) and defines the consumption and price data categories used in the IFFS runs made for that AEO. This report is written as a guide for persons who want to know or to replicate the definitions

of all of the DAS, IFFS, and AEO consumption and price categories. The DAS database is updated annually, based upon the annual updates of the various data sources which are used in its preparation. The first section of this report introduces the DAS database, format and present. The second section documents the database sources, which are primarily from the State Energy Data Systems (SEDS) and from the State Energy Price and Expenditure System (SEPES). The third section makes several comments, identifies certain problems, and makes some suggestions. The fourth section displays the national level consumption and prices for 1970 through 1983 from the DAS database. Finally, the last section identifies the files used for preparing the database on the EIA computer. 13 tabs.

23910 **(NP—5770235) Cyprus - energy situation 1983.** (Bundesstelle fuer Aussenhandelsinformation, Koeln (Germany, F.R.)). Nov 1984. 10p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770235.

A brief overview on the energy situation of Cyprus is given by means of significant data. Some comments are made on national energy policy, on the development of individual energy carriers from 1981 to 1983. In addition, figures are supplied concerning power production and consumption as well as foreign trade or balance of payment, respectively. The report relates to the greek-inhabited South of Cyprus only; no reliable energy policy data are available for the Northern part.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 23487, 23898, 23906, 23907, 23908, 23913, 23919

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 23431, 23432, 23436, 23464, 23468, 23478, 23479, 23484, 23487, 23493, 23494, 23495, 23496, 23893, 23893, 23898, 23956, 23957

23920 **(DOE/FE/60457—1) Uncertainties in industrial coal-based energy and feedstock utilization patterns. Final report.** Simbeck, D.R.; Moll, A.J.; Dickenson, R.L. (SFA Pacific, Inc., Mountain View, CA (USA)). Mar 1985. Contract AC01-84FE60457. 103p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85009751.

The use of coal in United States industry has not reached the levels anticipated in many of the projections of the past ten years. This report presents an analysis of factors affecting the use of coal in the three highly energy intensive US industries of chemical manufacturing, oil refining, and steel production. The analysis focuses on the outlook for expanded use of coal in each of these three industries. The outlook for coal use in the chemical, oil refining, and steel industries varies dramatically for each industry. Currently in the United States, about 55% of the required energy in the steel industry is met with coal, which is the traditional energy source for that industry. Of the three industries addressed in this report the steel industry uses far more coal than oil refining and chemicals combined. About 11% of energy required in the chemicals industry (not feedstocks) is met by coal, whereas only a fraction of a percent of refining energy requirements are met by coal. Direct coal consumption for these industries is illustrated for 1983. Not included is the additional coal which is used in the generation of purchased electricity. A complex variety of factors will influence future coal use in these three highly energy intensive industries. Moreover, the effects will likely differ significantly for each industry. 19 references, 7 figures, 25 tables.

2950 Hydrogen And Synthetic Fuels

23921 **(N—85-12182) Status of synthetic fuels and cost-shared energy R and D facilities.** (Committee on Science and Technology (U.S. Congress. House), Washington, DC). 1984. 408p. (GPO—36-903). Subcommittee on Energy Development Applications.

Financial budget for the following issues include: oil shale development; second-generation coal gasification; early experience and generic support to both gasification and direct liquefaction of coal; and supplemental liquids.

23922 **Synfuel development impacts - econometric modelling and policy analysis.** Solomon, B.D. (Federal Energy Regulatory Commission, Washington, DC). *Energy Policy;* 13: No. 1, 97-101(Feb 1985).

The prospects for rapid near-term development of a synfuel industry in the USA have decreased because of depressed world oil prices, synfuel project cost overruns, and the lukewarm support of the Reagan administration. Nonetheless, socioeconomic and environmental impact analysis studies can provide valuable information for determining the regional welfare effects of proposed projects. The author discusses the results of a regional econometric analysis of the synfuel projects planned for Western Kentucky, which focuses on environmental impacts, and reveals the inevitable tradeoffs that would accompany synfuel development. Some policy issues are briefly reviewed, especially that of efficient energy pricing. 25 references, 2 tables.

2960 Electric Power

REFER ALSO TO CITATION(S) 23464, 23744, 23750, 23751, 23752, 23936, 23956, 23994

23923 **(BFR-R—87-1984) Direct effect control of distribution network. Description of principles and planning.** Carlsson, I.; Kiluk, C.; Magnusson, P.G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 89p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751466.

Effect control is desirable for several reasons even if consumers are restricted in using untimely or excessive effects by tariff structures. A typical case for centrally controlled load distribution is production or supply breakdown or other disorders. Better control and management of consumption levels would in future be even more desirable for switching over to a different energy source including new ones now emerging. This project develops principle means for central load control, limiting or switching off some loads temporarily, or switch over between different sources, or for redistribution of loads for different time periods, e.g. for accumulation during low power demands. The first two parts of this project consisted of inventory and evaluation of customers in large and small distribution chains meriting central control measures. The present part, called -Data Handling and Transmission of Signals- analyses: load and network models, data program and data model, simulation and analysis had principles for installation and operation.

23924 **(DOE/RG/10506—T1) Assistance to low-income electric consumers: tabular analysis. Final report.** (Ebasco Business Consulting Co., New York (USA)). Mar 1982. Contract FC01-80RG10506. 289p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85010339.

The results of this tabular analysis show that while low-income consumers tend to consume lesser quantities of electricity than higher income customers, there is a sizable proportion of low-income consumers who consume more than 300 kilowatt-hours of electricity per month. Should a lifeline rate be adopted for the electric utilities in Massachusetts, limiting the lifeline block to under 300 kWh per month, would appear to assist a good number of low-income customers while minimizing the subsidization of higher income customers. The lifeline block length should consider the fact that it is not necessary to include the use of electricity for cooking, water heating, and space heating among the essential uses, if the intent of the rate is to assist the low income electricity consumer. The study also indicates that electricity consumption is related to the number of people in the household and the age of those residing in the household. Large families tend to use greater quantities of electricity than smaller families. Small families composed of persons 65 years of age or older tend to use less electricity than small families whose members are under 65. Additional study is required to determine the relationship between income and family size within each of the utilities' service areas. The use of electricity for cooking, house heating, supplemental house heating and water heating is more prevalent among higher income electricity consum-

ers than lower income electricity consumers. Weatherization programs appear to be an opportunity to assist low-income consumers with winter heating bills. 18 tabs.

23925 **(EPRI-EA—3793) Utility planning tools catalog. Final report.** Diamond, M. (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Feb 1985. 119p. Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $14.50. File Number TI85920547.

Planning methods new to the industry can help utilities steer a sound course in today's complex business environment. This catalog offers an overview of 23 innovative techniques drawn from other industries. The tools selected focus on supporting strategic analysis and decision making for utilities.

23926 **(ESC-WR—84-20) Aspects on controllability and reliability of the Dutch power production park mentioned in the reference scenario of the Ministry of Economic Affairs.** Van Wijk, A.J.M.; Alsema, E.A.; Turkenburg, W.C. (Stichting Energieonderzoek Centrum Nederland, Petten. Energie Studie Centrum). Dec 1984. 31p. (In Dutch). ECN, PO Box 1, 1755 ZG Petten, The Netherlands.

Calculations on reliability of the total Dutch power production capacity are made with simulation model SEPU. As calculated with the calculation model AREN a reserve factor of 1.37 must be maintained. This means that a maximum load of 11020 MW needs a production capacity of 15090 MW. Further conclusions are: a possibility to reduce power production to a fraction of its capacity and to increase the production again within a short period is necessary for a power plant to prevent unwanted outages; the energy storage system as proposed by Lievense, where energy is stored in a huge basin by pumping water in it, is not well dimensioned for a daily energy cycle. Pumping capacity must be increased significantly; by a better adaptation of loads the energy consumption curve might be flattened. The lower peaks permit lower total power production capacity. (A.V.)

23927 **(LiTH-IKP-R—332) Load control in industry.** Bjoerk, C.; Karlsson, B.G. (Linkoeping Inst. of Tech. (Sweden). Dept. of Mechanical Engineering; Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). Mar 1984. 166p. (In Swedish). (STU—81-5352). NTIS (US Sales Only), PC A08/MF A01. File Number DE85751454.

Fair prices of electric power are obtained by differentiated calculations which are based upon supply and demand. The principal aim of the Swedish industry is to increase the use of cheap electric power produced by hydroelectric and nuclear power plants during low load periods. An effort is also made to reduce peak power tops. An estimate of the potential of load control proposals has been made. The inventory shows the following items. Space heating - 14.7 TWh (oil substitution). Load priorities - 800 MW. Time shifting of loads - 270 MW. Increased use of electric power during low load periods - 1500 MW. Some of the energy can be conserved and some of it may assessed at right cost.

23928 **(PB—85-151181/XAB) Reassessment of the excess capacity issue.** Masud, E.; Agrawala, R.; Singer, R.; Luong, T.; Hansen, G. (Iowa State Commerce Commission, Des Moines (USA). Operations Review Div.). 15 Nov 1984. 128p. NTIS, PC A07/MF A01.

The purpose of the report is to reassess the 1984 Iowa generation reserve margin in view of allegations of data errors, model inaccuracies, and forecast uncertainties. The scope of the reassessment is as follows: (1) re-evaluate the 1984 Iowa Generating Reserve Margin (IGRM) study utilizing the best available data and the EGEAS model; (2) check the sensitivity of the results to reasonable load forecasts that might have been made in 1978 and 1981--the time at which studies to build or defer Louisa were completed by the Iowa utilities.

23929 **(STEV-TFS—84-4) Power generating system - analysis and calculations, using the ELFIN model, of some future developments.** Karlsson, S.; Plant, R. (Statens Energiverk, Stockholm (Sweden)). 1984. 162p. (In Swedish). NTIS (US Sales Only), PC A08/MF A01. File Number DE85751413.

ELFIN calculates for a number of years and for externally specified development of load and production system the yearly and weekly power generation for each generation category with regard to plant forced outage rates and load distribution. The model has been completed with a load model which calculates the hourly load for different electricity using sectors. Electric heating is simulated with energy balances for different types of houses. Insulation standards and different sources of free heat are incorporated in the model. This provide a capability to analyse the effects of different load characteristics developments and different measures for more efficient use of electricity. The use of ELFIN is exemplified with simulations of some alternative developments of the electricity system for the period up to the year 2010. For different load scenarios, new capacity of coal condensing power stations are compared to new capacity in windpower and wood fired cogeneration. The results from the ELFIN simulations show no evident advantage in total system costs for the different capacity shemes. But there is a factor between 1.5 and 6 increased smoke stack emissions of carbon dioxide, mercury, sulphur and nitrogen oxides in the coal condensing schemes. The potential for cogeneration with solid fuels under certain assumptions is estimated to 18 TWh/year, with todays commercial technology, and to about 29 TWh/year with new technology with small technological risks. With advanced technology the potential is further enhanced. A future electricity system without nuclear power will generate electricity for a consumption level corresponding to what would follow if presently known, best technology for electricity-specific end use, with 50-100 percent increase in consumption of goods and service.(author).

23930 **Immortal energy systems and intergenerational justice.** Weinberg, A.M. (Oak Ridge Associated Universities, TN). *Energy Policy;* **13**: No. 1, 51-59(Feb 1985).

Some critics of our technological society have asserted that we are leaving a legacy of problems for our descendants - in the shape, for example, of CO_2 pollution of the atmosphere and radioactive waste. The author argues that if some of our power generation systems turn out to be near immortal, with lives much longer than their book lives, we may, on the contrary, bequeath great benefits to our successors - in fully amortized plant with very low running costs. There are examples in history of similar benefits conferred by dams built hundreds of years ago but which still serve useful purposes today. 3 references.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 23888, 23917, 23918, 25086, 25087

23931 **(DOE/EIA—0035(85/01)) Monthly Energy Review, January 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 25 Apr 1985. 131p. NTIS, PC A07/MF A01 - GPO; GPO Dep. File Number DE85009599.

Current data on US production, consumption, stocks, imports, exports, and prices of principal energy commodities are reported for each month of 1982 through the most recent month of 1984, and for each year from 1973 through 1983. Quarterly summaries for the current year are also provided. Energy sources covered are crude oil, petroleum products, natural gas, coal, nuclear power, and electric utilities. Also reported are energy consumption by sector, selected energy indicators, and oil and gas resource development. For selected other countries in the world, production, consumption, and stocks of petroleum and electricity generation by nuclear power plants are presented. Conversion factors and a glossary are provided.

23932 **(LBL—19127) Low-income households and energy use in California.** Vine, E.L.; Gold, S.J. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010632.

This report examines the relationship between energy consumption and income with a particular emphasis on low-income households in California. The low-income population constitutes 10 to 20% of California's population, and almost 20% of these people live in the rural areas of California. While home energy use (pri-

mary electricity and natural gas) and payments of low-income households are less than those of other income groups, the former's "payment burden" (fraction of income spent on home energy) is as much as 350% greater than the burden for high-income households.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 23597, 23599, 23608, 23608, 23608, 23615, 23640, 23712

23933 (DOE/CE—0105, pp 39-48) **Biofuels.** Nov 1984. NTIS, PC A05/MF A01. File Number DE85001509.

In Renewable technologies program summaries.

Research in Biofuels has been performed in the following areas: short rotation cultivation; herbaceous energy crops; aquatic species; municipal waste preparation; thermochemical conversion (gasification, combustion, pyrolysis, liquefaction); biochemical conversion (fermentation, hydrolysis, anaerobic digestion). A regional program has been established to encourage production of biomass feedstocks and their conversion in the Northwest, Northeast, the Great Lakes, and the Southeast. The program is administered through the Office of the Assistant Secretary for Renewable Energy. An organizational chart is provided. (DMC)

23934 (DOE/CE—0105, pp 68-77) **Geothermal.** Nov 1984. NTIS, PC A05/MF A01. File Number DE85001509.

In Renewable technologies program summaries.

The DOE Geotehrmal Program is focused on providing the necessary scientific and engineering information to close technology gaps, and to reduce the cost of exploiting the more abundant moderate-temperature hydrothermal resources. The technology base resulting from this work will also have application to geopressured, hot dry rock, and magma resources. (ACR)

23935 **(ORNL/TM—9510) Methodology for assessing benefits and costs of governmental information collection.** Cantor, S. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010594.

A new approach is described for assessing the benefits and costs of information collected primarily for governmental policy development, planning, and program evaluation. Benefits are assessed by quantifying two judgments of the importance of obtaining the needed information: (1) the importance assigned to a specific item of information by users (usually individuals in government) who bear a degree of responsibility for achieving or pursuing a specific governmental objective, and (2) the importance of that objective, relative to other objectives, pertaining to the information topic. Benefits evaluated from these considerations are clearly nonmonetary, primarily useful for ranking the priorities for obtaining topically related information. One can characterize these (dimensionless) benefits as an index of importance or as a measure of "meaningfulness". A cost assessment, also dimensionless, is derived from six factors: (1) the number of respondents expected to supply the needed information; (2) the availability of data to the respondents; (3) the degree of accuracy required; (4) the frequency of data collection, (5) the level of disaggregation of the information; and (6) the time interval for transforming the raw data into (usually published) information in a more useful form. Costs estimated from these terms serve mainly to adjust the collection priorities associated with the benefit scores. However, these cost evaluations are also useful in estimating both dollar costs and respondent burden for developing new questionnaires as well as for modifying existing questionnaires. Implementation of this approach is illustrated by recent studies of Federal requirements for energy information. 5 refs.

23936 **(PB—85-149912/XAB) Public-policy issues of decentralized electricity production. Final report.** Ballard, S.C.; Chartock, M.A.; Devine, M.D.; Furnish, B.J.; Gunn, E.M. (Oklahoma Univ., Norman (USA). Science and Public Policy Program). Aug 1984. 455p. NTIS, PC A20/MF A01.

Decentralized electricity production (DEP) technologies are described, and are characterized as being small, being powered by renewable or waste fuels, being owned and operated by non-utilities, and being geographically dispersed. In 1983, approximately 22,500 MW of DEP capacity was installed, representing about 3 percent of the nation's generating capacity. By the year 2000, the capacity for DEP could be in the range of 46,000 - 80,000 MW, representing 6.8 to 8.6 percent of the present U.S. generation capacity. Utilities can affect DEP development in the establishment of purchase or buy-back rate and other contract terms; in addition, they can own and operate DEP facilities. Among DEP technologies, cogeneration may have the largest potential for growth. Estimates of potential capacity vary widely, but most estimates are between 20 and 200 GW of installed capacity by the year 2000. However, DEP planning may be necessary to achieve maximum cogeneration benefits. The effect of PURPA legislation, which has had a major impact, along with federal and state energy tax credits for some renewable sources on DEP technologies, is discussed.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

23937 **(DOE/ET/17019—20-Vol.1) Development of molten carbonate fuel cell power plant. Volume I. Final report.** (General Electric Co., Philadelphia, PA (USA). Advanced Energy Programs Dept.). Mar 1985. Contract AC02-80ET17019. 745p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85008743.

This report presents the technical results of a molten carbonate fuel cell power plant development program to establish the necessary technology base and demonstrate readiness to proceed with the fabrication and test of full-size prototype stacks for coal fueled molten carbonate fuel cell power plants. A broad, comprehensive effort covered power plant systems studies, fuel cell component technology development, fuel cell stack design and analysis, manufacturing process definition, and an extensive experimental program. The reported results include: the definition and projected costs for a reference coal fueled power plant system based on user requirements, state-of-the-art advances in anode and electrolyte matrix technology, the detailed description of an internally manifolded stack design concept offering a number of attractive advantages, and the specification of the fabrication processes and methods necessary to produce and assemble this design. Results from the experimental program are documented to verify that a repeatable, high level of performance was achieved, with system derived gas-conditions, for small scale cells. In addition, the status of work is reported for alternate cathode development, electrolyte management, corrosion studies, contaminant effects and other areas related to fuel cell materials selection and component definition. Areas requiring further development or demonstration are identified. The reported results provide a technical basis for proceeding with the scale-up and optimization of the molten carbonate fuel cell design.

3003 Thermoelectric Generators

REFER ALSO TO CITATION(S) 23633

3005 Fuel Cells

23938 **(DOE/ET/17019—20-Vol.2) Development of molten carbonate fuel cell power plant. Volume II. Final report.** (General Electric Co., Philadelphia, PA (USA). Advanced Energy Programs Dept.). Mar 1985. Contract AC02-80ET17019. 608p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85008742.

This report presents the technical results of a molten carbonate fuel cell power plant development program to establish the necessary technology base and demonstrate readiness to proceed with the fabrication and test of full-size prototype stacks for coal fueled molten carbonate fuel cell power plants. A broad, comprehensive effort covered power plant systems studies, fuel cell component technology development, fuel cell stack design and analysis, manufacturing process definition, and an extensive experimental program. The reported results include: the definition and projected costs for a reference coal fueled power plant system based on user requirements, state-of-the-art advances in anode and electrolyte matrix technology, the detailed description of an internally mani-

folded stack design concept offering a number of attractive advantages, and the specification of the fabrication processes and methods necessary to produce and assemble this design. Results from the experimental program are documented to verify that a repeatable, high level of performance was achieved, with system derived gas-conditions, for small-scale cells. In addition, the status of work is reported for alternate cathode development, electrolyte management, corrosion studies, contaminant effects and other areas related to fuel cell materials selection and component definition. Areas requiring further development or demonstration are identified. The reported results provide a technical basis for proceeding with the scale-up and optimization of the molten carbonate fuel cell design.

23939 **(DOE/MC/12837—1761) Coal processing for fuel cell utilization Task VIII, H_2 removal by calcium-based sorbents.** Simons, G.A.; Rawlins, W.T. (Physical Sciences, Inc., Woburn, MA (USA)). Mar 1979. Contract AT21-79MC12837. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85003371.

Equilibrium calculations indicate an optimum thermodynamic limit of $(H_2S)/(H_2O) \approx 10^{-3}$ for a typical fluidized bed gasification process using limestone or dolomite at temperatures of 1000 to 1200°K; thus, the minimum H_2S level which can be attained in the gasifier is probably near 100 ppM. Detailed kinetic investigations have shown that the kinetic rate constant for CaO with H_2S is of the same magnitude as that with SO_2 and that the activation energy for both reactions is less than 10°K cal/mole. The late time reactivity of H_2S is higher than that of SO_2 because the formation of CaS does not completely obstruct the porous structure of CaO, as does the formation of $CaSO_4$. Empirical evidence of this is demonstrated by the increased CaO utilization with H_2S as opposed to SO_2. The CaO conversion with SO_2 is 40%, whereas that with H_2S is 90%. This offers clear evidence that the sulfur deposits play a role in the late time reactivity. Hence, the next step in the modeling of sulfur cleanup by limestone must include the effects of the sulfur deposits. Such a model would not only yield the late time reactivity, but it would indicate the operating conditions under which CaO utilization could be maximized. In addition to developing a model which includes the effects of sulfur deposits, we must determine the effects of the calcination temperature and CO_2 background on the pore structure. In particular, the work of Ruth et al. on the reaction of H_2S with $CaCO_3$ calcined in situ clearly shows the effects of these conditions on the transition from high reactivity at early times to lower reactivity at late times. These effects are important for CaO utilization and additional empirical work is required before a theoretical model can be constructed. 14 refs., 19 figs., 2 tabs.

23940 **(LBL—18281) New catalysts and new electrolytes for acid fuel cells.** Ross, P.N.; Appleby, A.J. (Lawrence Berkeley Lab., CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Feb 1985. Contract AC03-76SF00098. 14p. (CONF-840805—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009940.

From 188. meeting of the American Chemical Society; Philadelphia, PA, USA (26 Aug 1984).

Based on the characterization studies and the behavior of the model systems, it appears that the promotion effect of oxides of Ti, V, Zr, Ta and Cr is probably not truly catalytic. The most probable mechanisms are changes in physical properties of the Pt catalyst in the dry state which result in improved electrode performance due to two effects: (1) a Pt crystallite shape/morphology effort, where the base metal oxide acts to impede Pt crystallite size growth (by coalescence) but allows surface diffusion to occur and equilibrium shapes to form during heat treatment; (2) the oxide acts as a flux for improving the wetability of the catalyst when fabricated into a gas diffusion electrode, resulting in higher catalyst layer effectiveness. Both of these effects have been discussed in the literature, but not with respect to how additives or promoters might relate to such effects. Recent work has shown that use of concentrated trifluoromethane sulfonic acid (TFMSA) in place of concentrated phosphoric acid enhances the activity of standard Pt electrodes for oxygen reduction by 40 mV (which could improve the heat rate of first-generation fuel cells by 400 Btu/kWh). It shows the real possibility that the catalytic activity of platinum-based catalysts in phosphoric acid can be improved under utility fuel cell conditions by the use of new electrolytes, especially fluorinated sulfonic or phosphoric acids. However, trifluoromethane sulfonic acid is much too volatile for practical use in utility fuel cells. Efforts to synthesize suitable non-volatile, stable fluorinated sulfonic acids to replace phosphonic acid have been moderately successful and are continuing. 20 references.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

23941 **(DOE/R5/10197—T1) Model energy audit program guidelines.** (Stewart (Sam) and Associates, St. Paul, MN (USA); Pawlak (Ann) and Associates, Inc., St. Paul, MN (USA)). 1980. Contract FG45-80R510197. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85010421.

Six existing US DOE programs contain energy audit requirements. They overlap, are inconsistent, and in general are difficult to understand. This model program guideline has at least three potential uses: It can be applied to existing programs to eliminate inconsistencies and clarify technical points. It can be consulted during the formulation of future programs with energy audit components. It can be shared with state and local governments. This document actually contains two model energy audit program guidelines - one for commercial, institutional and industrial buildings and industrial processes, and one for residential buildings.

3201 Buildings

REFER ALSO TO CITATION(S) 23668, 23680, 23744, 23878, 23891, 23990, 24308

23942 **(ASHRAE/SP—28) Thermal performance of the exterior envelopes of buildings: proceedings.** Bales, E.; Bass, L.B. (eds.). (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York; USDOE Assistant Secretary for Conservation and Solar Energy, Washington, DC. Office of Buildings and Community Systems). 1981. Contract W-7405-ENG-26. 995p. (CONF-791233—). NTIS, PC A99/MF A01. File Number DE83014620.

From Conference on thermal performance of the exterior envelopes of buildings; Orlando, FL, USA (3 Dec 1979).

Separate abstracts were prepared for individual papers. (MHR)

23943 **(BFR-R—12-1984) Room ceiling heating - energy consumption and indoor climate.** Johansson, C.; Pettersson, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 109p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85751463.

A test room with two cooled walls, ceiling and floor and two dividing innerwalls and window, forced ventilation was used to compare electric ceiling heating with conventional electric wall panel heating with regards to energy consumption, air temperature distribution and operating temperature. The influence of floor insulation thickness, furniture, additional heat influx, ventilation, varying installed effects, and type of control system has been studied. Ceiling heating gave more uniform temperature distribution in both vertical and horizontal planes and a higher surface temperature on walls and floor at same air temperatures, especially regarding the floor. Floor insulation has greater influence on surface temperature, however, when panels are used. Ceiling heating element location and surface effect has a bearing on room temperature distribution. Cold air downflow is reduced by placing ceiling elements near window or baldy insulated walls, but result in larger differences of operating temperatures in various directions result. Temperature cycling results in quicker adjustments of directed operative temperatures in the case of ceiling heating, response depending naturally also on installed effect. But air temperatues rise quicker with wall panels at equal installed effects. Energy consumption varies according to system and which effect is compared, namely: operative temperature, air temperature, directed operative temperature, floor temperature, with and with out ventilation. Increase of ventilation and furniture results in higher consumption, but lesser for ceiling heating. Differences are from 1-7 percent in the test room, however, in reality smaller ones are likely and practical factors of con-

struction, building type, lay-out, and heating management may overrule. Electronic sensors give quicker control action than thermocouples.

23944 **(BFR-R—13-1984) Taeby project. Energy saving houses at Taeby.** Lindskoug, N.E. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 277p. (In Swedish). NTIS (US Sales Only), PC A13/MF A01. File Number DE85751462.

Final report.

The project was started by the Energy Program Committee and the Swedish Council for Building Research in 1974/75 to construct model houses with low energy consumption. Several private firms, government agencies and Technical Universities joined later. The present state of knowledge, technology and skills should be assessed prior to going into mass production. Valuable experience was gained during the construction of more than 24 houses with 5 variants and tests lasting until summer 1981. The main results are: Complicated multi-control systems for small isolated houses cannot satisfactorily managed at present. Even separate houses can be built economically with low consumptions. Waste air heat recuperators are economical only if very air tight construction can be achieved and maintained. Hygiene and comfort demand total ventilation. Heat pumps need further development. Solar heat collection for tap water will only be competitive at lower costs. This applies to space heating too. The project resulted in a valid system for calculating energy balances, when the relative importance of different types of energy losses and savings can be predicted. Energy balance measurements showed that identical houses have energy consumptions figures differing by only 2 percent, the uncertainty is spread over +- 3 percent. Energy gains from energy saving measures as calculated between reference and test houses agree with directly measured values. New theories on ventilation and heat exchange agree with direct and indirect measurements. The statistical analysis applied here confirm all important test data.

23945 **(BFR-R—16-1984) Passive solar energy technology. Description and evaluation of a small house at Vaexjoe.** Blomsterberg, Aa.; Ulmaas, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 135p. (In Swedish). NTIS (US Sales Only), PC A07/MF A01. File Number DE85751421.

During 1982 the measuring program developed by Solar Energy Research Institute, SERI, USA, was applied to a small single storey house with a floor area of 155 m^2 incorporating a glassed green house area of 22 m^2 with a gravel bed for heat storage. Walls have a k-value of 0,15 W/m^2 degreeC, ceiling 0,11 W/m^2 degreeC and floor 0,18 W/m^2 degreeC. Windows are of triple glazing type and no window is facing north. Good air thightness was aimed at. The ventilation system balances automatically stored heat with warm air electrically generated to desired room temperatures which are controlled by room thermostats in the recirculating air ducts. Both the gravel bed solar heat sink and direct solar heat is used. The air collected from under the green house gravel bed is forced by fan through the bed and back again to the house is returned to the green house by heat ducts in the floor. More than 12 months control measurements and evaluations were aimed at an analysis of the climatic conditions for various operating situations in order to assess the systems energy saving propensity and to make recommendations for improvement. A data log system was during the test period permanently linked by telephone cable to a central computer. Results and conclusions point to a saving of 24 percent of energy (kWh) compared to the calculated requirement of a well built 1/half storey comparable small house according to Swedish Building Norm 1980 (SBN 80). Savings can be improved by applying a number of practical measures as a result of the experiment, in particular by -installing window insulation in the green house -improving and simplifying the heat sink function in the green house, -removing ventilation channels between heat sink and heating plant as they proved to superfluous, - improving the ventilation system, -increasing recirculated air mass in order to reduce warm air temperature, -improving leak tightness, -conducting detailed energy calculations before building the house.

23946 **(BFR-R—48-1984) Successful energy economy, what is that.** Elmberg, A.; Lindmark, J.; Peterson, U. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 47p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751424.

For Gothenburg applies 1. normal annual consumption of energy during 1977 and 1978 for heating and household consumption, as bought by house owners, of 270 kWh/m^2 for - primary use area - 2. A decrease of that figure in 1982 to 225 kWh. 3. a possibility of reducing that figure to 100 kWh by using available techniques, and 4. a reduction to 50 kWh/m^2 in houses where installation of exhaust air heat pumps is feasable. Continued information directed to house owners are believed to bring about further economies if energy saving measures even without state subsidies are profitable to house owners and if a long term view is taken considering e.g. maintenance needs and rebuilding programs.

23947 **(BFR-R—50-1984) Physical effects of surface heat extraction. Simulated extraction from various soils and climates.** Jansson, P.E.; Lundin, L.C. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 81p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751425.

The present theoretical study links an earlier study with an extensive 3 years practical ecologic experiment in 1978 at Hacksta (Stockholm region) and uses a one-dimensional model based on a numerical solution of two partial differential equations to describe the dynamics for temperature and water conditions in six different soil profiles, three locations in Sweden and five different heat extraction regimes. The simulation is based on the heat requirements of a single family house extracting energy at 80 cm depth in the soils. Soil climate is characterized as usually defined in bioclimatology. The greatest sensitivity towards heat extraction was found for the early vegetation season and especially for deeper levels; the least for the end of the season, i.e. when soil temperature at 30 cm depth permanently was below + 5 degreeC. Differences in soil profiles depend on location and the magnitude of soil climate under discussion. Bog profile was here often unique compared with mineral soils, e.g. permafrost would obtain upon extraction of 125, 122 or 250 MJm^{-3} $year^{-1}$ in all three locations, etc. Also, the depth level for soil collectors were most critical for bog profiles. A deeper heat collector location meant an earlier start of the vegetation season and a warmer surface layer, but also a greater risk for permafrost. Heat extraction distribution in time was more important in southern than in northern Sweden. Snow layers are naturally of great importance for effects on surface soil extractions particularly during a cold winter with quantities of snow. The soil inertia upon change from the natural condition to heat extraction mode and vice- versa was also simulated. Reality may show of course large discrepancies against theoretical results in isolated cases but general trends here presented from simulation are believed to be a useful guidance for the estimation of effects obtained at different levels of heat extraction from soils.

23948 **(BFR-R—75-1984) Heat extraction from clean water supplies by heat pumps. A study at Aakarp.** Lemmeke, L.; Luterkort, S.; Persson, U. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 43p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751465.

This pre-study sets out to investigate the use of heat pumps in a clean water supply systems in regard to technical, safety, and economical factors. An existing heat pump and service network was used as a test bed model. The cooling of clean town water following heat extraction is partly compensated by heat influx from the surrounding soil which however could not be accurately predicted. The risk of contamination in heat exchangers particularly in stoppages can be eliminated and best by an extra intermediate heat exchanger and loop. Economically it appears to be better to use other heat sources, e.g. the water table, waste water, industrial process water, etc.

23949 (BFR-R—107-1984) More effective use of energy in conjunction with renovation and modernization. Field methods and aids. Andersson, M.; Lund, C.E. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 86p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751451.

The current review of codes and forms of financing accentuates the need for methods and aids for housing improvement projects and energy conservation measures. In order to ensure a good result, a systematic working method should be employed in conjunction with renovation and modernization projects. Furthermore, in order that total annual costs during the management stage may be successfully reduced, the measures should be based on an evaluation of the building as a total system. This report lists the methods and aids which should be devised. For instance it is suggested that a manual for preliminary surveys should be drawn up. A process for renovation and modernization projects is described and illustrated in a practical case. Calculation and documentation of the energy consumption are discussed, as well as the relationship between calculations and measuring methods. The needs discussed in the report should result in a number of coordinated subprojects with the responsibility for implementation resting on different organizations. In most cases the methods and aids can be based on existing information, but in order that the results obtained may be quickly translated into practical use resources must also be allocated for information and training.

23950 (BFR-R—109-1984) Seasonal variation of the efficiency of oil fired boilers. Blomquist, R.; Welin, B. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 28p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751452.

The object of this investigation has been to measure the efficiencies of different types of oil fired boilers so that a check can be made on efficiency during the summer months. Four natural draught type boiler plants were equipped with heat meters, running time meters and, in certain cases, with oil consumption meters. The efficiencies were measured by comparing the energy supplied with that produced according to the heat meter. For boiler plants without draught regulation, the following conclusion can be drawn regarding the relationship between efficiency and running time: The efficiency of a boiler rises linearly from 60 percent at 5 percent running time to 80 percent at 25 percent running time. The results show efficiencies of over 75 percent in boiler plants fitted with draught regulation equipment. Since this equipment also has a favourable effect on efficiency during the rest of the year and, in addition, is not particularly expensive, provision of this should be considered when the cost effectiveness of different types of heating plant is compared.

23951 (BFR-R—112-1984) Energy supply options for existing apartment houses. Long-range comparison of heat pumps and district heating at Malmoe. Luterkort, S.; Lemmeke, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 81p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751468.

A comparison of alternative energy supplies from heat pumps using sources like top soil, water table or waste air against district heating has been conducted in order to replace oil for two apartment houses built towards end of 1950ies. Heat requirements are relatively low, 150 kWh/m^3, among 21000 apartments owned by the town council which have an average value of over 200 kWh/m^2. Due regard was taken to important technical, financial, judicial, environmental and economic factors. The best is to link up with the district heating network. Heat pumps extracting energy from the water table or soil are good alternatives, but impractical in densely built up areas as in this case. Waste air is the third choice but does contribute only 20 percent of total requirement. Environmental regards speak for district heating and heat pumps. However, the oil burning boiler will be retained in any case to satisfy peak demands.

23952 (BFR-R—114-1984) Natural gas operated heat pumps in SYDGAS network. Preparatory study. Matsson, L.O.; Landare, S.; Wanselius, K. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 71p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751469.

Natural gas which is cheaper and cleaner than town gas will be introduced in the south of Sweden by 1985 by SYDGAS. Different principles for natural gas operated heat pumps are shown. A number of natural gas operated heat pumps are described, Otto-, Sterling engines, gas turbines, adsorption pumps. A rough indication of effects on the network is described if heat pumps are used, environmental effects are described though they are less abnoxious than oil or coal. Data was gleaned from literature and enquiries to manufacturers, etc.

23953 (BFR-R—127-1984) Converting heat central for production of heat and mechanical energy for heat pumps. Nordling, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 22p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85751448.

A superficial economic comparision is given between two different systems for covering the base load in a district heating system. A solid fuel steam boiler with a turbine driven heat pump is compared to solid fuel fired hot water boilers with and without electric heat pumps. With todays Swedish energy prices, the system with a steam turbine driven heat pump is most economic. This relation holds as long as the price of solid fuels is at least 0.1 SEK cheaper /kWh than that of electricity. If the price difference is less than 0.08 SEK /kWh, solid fuel fired hot water centrals get the advantage. A more detailed study of the steam turbine driven heat pump system is finally suggested.

23954 (BFR-R—128-1984) Gas driven heat pump for the district heating system at Oxie, Sweden. Preliminary study. Luterkort, S.; Torisson, T.; Lemmeke, L. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 42p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE85751449.

Three alternatives are being considered for the heat supply of the district heating system in Oxie. A. A natural gas engine driven heat pump and gas boilers. B. Natural gas boilers only. C. Connection of the Oxie system to the nearby Malmoe district heating network. In this report alternatives A and B are discussed. For alt. A ground water will be used as a heat source, a water flux of 330 m^3/h is available. 1/3 of the power from the heat pump plant is generated as waste heat in the gas engine, a two-stroke Otto engine with a shaft power of 700 kW, 80 percent of the heat demand will be covered by the heat pump plant. Investment costs are for A: 8.52 MSEK, B: 2.30 MSEK. The overall heat cost is however lower for alt. A than for alt. B. Alt. A is also less sensitive to natural gas cost increases.

23955 (BFR-R—168-1984) Stockholm-project-Roofintegrated air-solar-collector and air-heating in the block -Kejsaren-, Stockholm. Werner, G. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 75p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751453.

The report describes developing and design work of a low-energy house with ten apartments in five storeys. The house has a Roofintegrated air-solar-collector, heat storeying in the concrete floor with air-channels, air-heating and distribution systems. The project is one of five experimental houses in the so called -Stockholmsprojektet- which is a research project for low energy technics in multi-family buildings in cooperation between the community of Stockholm and the Swedish Council for Building Research.

23956 (CONF-830669—, pp 78-85) **Assessment of climate impacts on the energy industry.** Warren, H.E.; LeDuc, S.K.; Hock, J.C. (National Oceanic and Atmospheric Administration, Columbia, MO). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

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Climate fluctuations have a significant influence on energy consumption in the US. The Assessment and Information Service Center, National Oceanic and Atmospheric Administration, has developed an impact assessment methodology for electricity and natural gas consumption in the residential and commercial sectors. An extension of these models provides a comparative analysis of the interannual changes in monthly home-heating bills for natural gas and fuel oil. Changes in the bills are analyzed as component changes in weather, price, and conservation.

23957 (CONF-830669—, pp 31-34) **Use of appropriate weather data in energy demand modeling.** Rodekohr, M.E. (Energy Information Administration, Washington, DC). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

The use of consumption-weighted heating degree data is examined as opposed to population-weighted data in estimating the demand for heating oil. Most, if not all, energy demand estimates are based on the use of population-weighted heating degree-day data, which reflect the distribution of total population rather than the distribution of homes that use heating oil. This causes measurement error. The analysis herein demonstrates that use of the correctly weighted series produced significantly different estimates of a typical heating oil demand function.

23958 (CONF-831204—) **Energy efficiency in buildings and industry.** Williams, T.E. Jr. (ed.). (Government Institutes, Inc., Rockville, MD (USA)). Jun 1984. 722p. Government Institutes, Inc., 966 Hungerford Dr., No. 24, Rockville, MD 20850. File Number TI84013400.

From 2. Mid-Atlantic energy conference and exposition; Baltimore, MD, USA (6 Dec 1983).

Separate abstracts were prepared for individual papers. (MHR)

23959 (CONF-8310110—) **Families and energy: coping with uncertainty. Conference proceedings.** Morrison, B.M.; Kempton, W. (eds.). (Michigan State Univ., East Lansing (USA). Inst. for Family and Child Study). May 1984. 726p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85000086.

From Conference on families and energy: coping with uncertainty; East Lansing, MI, USA (9 Oct 1983).

Separate abstracts were prepared for individual papers. (MHR)

23960 (DOE/CE/64780—T2) **[Energy accounting software]. Quarterly progress report.** (Unified Industries, Inc., Springfield, VA (USA)). 1985. Contract FG01-84CE64780. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010612.

This informal document reports activities on energy accounting and software for institutions and buildings in various states. (DLC)

23961 (DOE/CS/20469—T1) **Weatherization demonstration project. Final report.** (United Planning Organization, Washington, DC (USA)). 9 Aug 1980. Contract FG01-77CS20469. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010200.

This Retro-tech Demonstration Project can be viewed as successful. Although the average energy savings were not as large as we hoped (12.8% vs an expected savings of 20%), it is the purpose of Demonstration Projects to demonstrate concepts and point out where they should be improved before a given program is implemented in full scale projects. This Project demonstrates that for old urban communities such as Washington, DC, the $400 per dwelling unit is not realistic and should be replaced by a total dollar limit per weatherization project and how these dollars are allocated should be determined by the project manager. This allows the money allocation process to more accurately reflect the prevailing housing stock and will in the end allow for a more optimum expenditure of resources.

23962 (DOE/R3/02445—T1) **Analysis and demonstration of fuel-free cooling and lighting device. Final report.** (Hearthstone Studios, Richmond, VA (USA)). 29 Sep 1982. Contract FG43-80R302445. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008497.

Presented are the production and testing of a sun shade device. The sun shade consists of a toothed metal angle (called the jamb member) and a webbing, woven of precisely formulated filaments, which is laced horizontally from tooth to tooth of the jamb member. Testing was performed in air-conditioned and non-air-conditioned rooms of school buildings in three different climatic areas of Virginia. During a 365 day period, interior temperatures and light were monitored and continuously recorded for each room. (BCS)

23963 (DOE/RG/08086—T1) **Conclusions and recommendations for electrical energy conservation based on the Washington Rate Demonstrations Project.** Kohlenberg, R.J.; Anschell, S. (Washington Univ., Seattle (USA)). 30 Jun 1980. Contract FC01-78RG08086. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010312.

Based upon indications from previous research, a set of studies were conducted by a University of Washington research team to further explore the potential of using feedback to bring about conservation of electrical energy. Specifically, individual studies focused on feedback in the form of the utility bill itself when that bill reflects an increased rate; a more informative bill; daily meter readings; instantaneous information on electricity used in showers; continuous feedback on energy use by a household or a business as a whole; rebates; hints on achieving conservation; and meter-reading instructions. In gereral, the interventions found most effective entailed the use of feedback at relatively frequent intervals and in combination with an incentive or some other positive involvement of the subject. Thus (moderate) rate increases were found most effective for a short period after their implementation, and a month of daily meter readings resulted in significantly lower electricity use for about a year after the readings had been stopped. A shower-flow restrictor that involved the subject by enabling him to make adjustments in flow also seemed to hold promise for achieving significant conservation. Neither rebates nor non-contingent conservation information were found effective in producing energy conservation.

23964 (LBL—17074) **Applied Science Division annual report, Energy Analysis Program, FY 1983.** (Lawrence Berkeley Lab., CA (USA)). Sep 1984. Contract AC03-76SF00098. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85004441.

The Energy Analysis Program is engaged in interdisciplinary activities in which analysts from different fields work together on issues of national significance. The Program's emphases on economics, public policy, and behavioral science distinguish it from other LBL activities. At present, the Energy Analysis Program emphasizes the study of energy use in buildings. This subject has been stressed for a number of reasons; one of the most important is the strong research effort within the Applied Science Division on energy conservation in buildings (especially the Energy Efficient Buildings and Solar Energy programs). The Energy Analysis Program provides a rigorous and extensive analytical capability that complements the more technical pursuits of other groups in the Division involved in building energy research. The Program will continue to emphasize analysis of energy use and efficiency in buildings, and it is also applying techniques to other important national and international energy and resource policy issues. The projects provide a good beginning to a systematic analysis of the issues studied. Papers have been entered individually into EDB and ERA.

23965 (LBL—17774) **Seasonal storage of moisture in roof sheathing.** Cleary, P.; Sherman, M. (Lawrence Berkeley Lab., CA (USA)). Dec 1984. Contract AC03-76SF00098. 21p. (CONF-850441—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009957.

From Moisture and humidity symposium; Washington, DC, USA (15 Apr 1985).

Classic research into attic moisture problems tended to concentrate on the static prediction of instantaneous temperatures at the underside of the roof sheathing, which was regarded as an inert medium. However, recent work has demonstrated the existence of daily and seasonal cycles in attic moisture parameters. Over the course of a day, the attic air humidity may vary by a factor of three, and during the course of a winter there is storage of perhaps 45 kg (100 lb) of water in the roof sheathing and roofing trusses. On a daily basis the moisture flow is quite significant, of the order of 2 kg per hour (5 lb per hour); this is far greater than the moisture generation rate in a house, which is typically 0.45 kg per hour (11 per hour). The daily cycles suggest that as the roof sheathing is warmed by incident solar radiation, water is driven off and removed by the ventilation air. A simple method to predict the seasonal variation of wood moisture content has been developed by considering the hour-by-hour transport of water into and out of the wood surfaces of the attic. To validate the model, hour-by-hour measurements of wood resistance, attic and outside dew-point and meteorological variables were made over a four-month period on an unoccupied house in Oroville, CA. The roof sheathing moisture content was found to vary from approximately 14% in December to 7% in early April. Measurements are compared with predictions. 15 refs., 7 figs.

23966 (LBL—18025) Onset of freezing in residential air-to-air heat exchangers. Fisk, W.; Chant, R.; Archer, K.; Hekmat, D.; Offermann, F.; Pedersen, B. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 36p. (EEB-Vent—84-22; CONF-850123—3). NTIS, PC A03/MF A01; GPO Dep. File Number DE85009960.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Chicago, IL, USA (27 Jan 1985).

Mechanical ventilation of residences, with heat recovery in air-to-air heat exchangers, is an increasingly common practice. When this technique of ventilation is used in cold climates, however, freezing can occur in the air-to-air heat exchanger and substantially reduce its performance. A laboratory investigation was conducted to determine the indoor and outdoor environmental conditions that lead to freezing. In a cross-flow, counterflow, and enthalpy-type cross-flow heat exchanger, respectively, freezing was observed when the inlet temperature of the cold airstream was below -7 to -3°C, approximately -6°C, and -8 to -12°C, for a typical range of indoor humidities. These results are in fair agreement with the theoretical predictions presented in this paper and with data from two field studies conducted with similar heat exchangers. Data from a previous laboratory study of a counterflow heat exchanger and tabulated data supplied by ASHRAE, however, indicate that freezing is initiated at significantly lower cold airstream temperatures, particularly when the warm airstream is humid. 10 refs., 7 figs.

23967 (LBL—18062) Moisture control by attic ventilation: an in-situ study. Cleary, P. (Lawrence Berkeley Lab., CA (USA)). Jul 1984. Contract AC03-76SF00098. 24p. (CONF-850606—1). NTIS, PC A02/MF A01. File Number DE84016877.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Moisture enters an attic both from the house and from the ventilation air. It has been assumed that when the roof sheathing temperature cools below the attic air dew point, condensation occurs on the roof sheathing. If this were true, then increased attic insulation levels would require increased attic ventilation rates. Results from an experimental study are presented which show that in fact the roof sheathing is in dynamic equilibrium with moisture in the attic air, and that several hundred pounds of water can be stored in the attic wood without ill effects. A model of this process is presented, and used to predict hour-by-hour and seasonal moisture levels. Applications of the model are discussed. 19 refs., 11 figs.

23968 (LBL—18299) Electrochromic and thermochromic materials for solar energy applications with emphasis on niobium and vanadium oxides. Jorgenson, G. (Honeywell, Inc., Minneapolis, MN (USA)). Aug 1984. Contract AC03-76SF00098. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010630.

Based on this literature search on electrochromic and thermochromic materials for use in solar energy control, recommendations are made for future development activity. The possibilities for using doped VO_2 to control solar energy influx through building glazing should be investigated. Most of the research on electrochromic materials is directed at their use in displays. To determine their usefulness for solar energy control through building glazing requires performance of further investigations which are outlined. Building glazing comprised of EC devices with fluidic electrolytes are probably impractical. There is good, but not irrefutable, evidence that bulk NbO_2 will switch electrically when an electric field is applied in the right direction relative to the crystal orientation. Honeywell Systems and Research Center has been working on depositing thin film NbO_2 that will switch electrically. Although there has been some success, much work is still needed to have good devices. 131 refs.

23969 (LBL—18543) Commercial-sector conservation technologies. Usibelli, A.; Greenberg, S.; Meal, M.; Mitchell, A.; Johnson, R.; Sweitzer, G.; Rubinstein, F.; Arasteh, D. (Lawrence Berkeley Lab., CA (USA)). Feb 1985. Contract AC03-76SF00098. 359p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE85010642.

This report describes and documents selected commercial-sector energy conservation technologies and strategies with special emphasis on their application in the Pacific Gas and Electric and the Southern California Edison service territories. The primary topics are space cooling (equipment, loads, systems), air tranpsort, refrigeration, electric motors, electric lighting, and daylighting and fenestration. The report presents cost, energy and power savings, lifetime, product reliability, and related information for each of these topics. Documentation, with field performance data where possible, is also included. Secondary topics, (covered in substantially less detail) are energy management and control systems, natural gas cooking, and natural gas space heating equipment. Gaps in information and future research needs are also highlighted.

23970 (LBL—19035) Electrodeless HID lamp study. Final report. Anderson, J.M.; Johnson, P.D.; Jones, C.E.; Rautenberg, T.H. (Lawrence Berkeley Lab., CA (USA); General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Jan 1985. Contract AC03-76SF00098. 62p. (EEB-L—85-01). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010626.

High intensity discharge lamps excited by solenoidal electric fields (SEF/HID) were examined for their ability to give high brightness, high efficacy and good color. Frequency of operation was 13.56 MHz (ISM Band) and power to the lamp plasma ranged from about 400 to 1000 W. Radio frequency transformers with air cores and with air core complemented by ferrite material in the magnetic path were used to provide the voltage for excitation. Electrical properties of the matching network and the lamp plasma were measured or calculated and total light from the lamp was measured by an integrating sphere. Efficacies calculated from measurement were found to agree well with the positive column efficacies of conventional HID lamps containing only mercury, and with additives of sodium, thallium, and scandium iodide. Recommendations for future work are given.

23971 (ORNL/CON—113) Benefits of replacing residential central air conditioning systems. McLain, H.A.; Goldenberg, D.; Karnitz, M.A.; Anderson, S.D.; Ohr, S.Y. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 71p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010577.

The energy efficiency ratios (EERs) of marketed residential air conditioning equipment have increased during recent years. This investigation examined the benefits of replacing a unit having an EER of 6 with a unit having an EER of 10 in a prototypical two-

story house located in each of 32 cities in the United States. The US Department of Energy building simulation model, DOE-2.1A, was used to predict the energy savings associated with this action. The reasonableness of the model for this study was confirmed by comparing the DOE-2.1A predicted energy use data with measured energy use data for the Tennessee Energy Conservation in Housing (TECH) control house in Knoxville, Tennessee, and four specially metered houses in Little Rock, Arkansas. It was predicted that the seasonal energy efficiency ratios (SEERs) of correctly sized units would vary from 0.6 of the rated EERs in the northern part of the country, to 0.8 of the rated EERs in the middle part of the country, and to about the rated EERs in the lower southern part of the country. Oversized units were predicted to have lower SEERs. These values reflect the total annual energy consumed by the air conditioning units, including the energy used by the crankcase heaters. From these results, a simplified Residential Conservation Service Model Audit procedure for estimating SEERs from EERs was developed. Using 1982 capital and electrical energy costs, simple payback periods were calculated to be as low as 5 years in the lower south regions to about 10 to 15 years in the upper south regions. If the air conditioning unit needs replacement, the simple payback period for the incremental cost of installing a high-efficiency unit was calculated to be about 2 to 5 years in these regions. Further savings would be realized if existing oversized units were replaced with properly sized, high-efficiency units. 15 references.

23972 **(PB—85-149730/XAB) Development of a pulse combustion space heater. Annual report, June 1983-May 1984.** Thrasher, W.H.; West, J.L. (American Gas Association Labs., Cleveland, OH). Jun 1984. 114p. NTIS, PC A06/MF A01.

See also PB84-175033.

A twelve-unit field test of a newly developed high-efficiency pulse combustion space heater was accomplished during the 1983-1984 heating season at ten test-sites located throughout the country. The safety, reliability and satisfactory operation of the design was demonstrated. The test site occupants considered the comfort level and warm air distribution provided by the heater to be good. The sound level generated by the combustor system was low and considered acceptable by the residents; however, they did object to the noise generated by the circulating air blower. A modification to the circulating air blower reduced the sound level slightly. The field-test units operated in a condensing mode and had stead-state thermal efficiencies in excess of 90 percent. Operation of several of the units in cold climates indicated that the vent system remained open and there was no problem with freezing of condensate.

23973 **(PNL—5123) BEPS redesign of 168 commercial buildings: summary report.** Stoops, J.L.; Deringer, J.J.; Moreno, S.; Misuriello, H.P. (Pacific Northwest Labs., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 291p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE85003277.

The objective of this report is to present, in usable form, summary data from the Building Energy Performance Standards (BEPS) Phase II commercial buildings energy research conducted in 1978-1979. Summary data presented were obtained from two major research efforts: the BEPS Phase II Redesign experiment; and the related research on ASHRAE Standard 90-75R. The bulk of this report consists of data tabulations of key energy parameters for the 168 sample buildings, which were tabulated from computer-stored files of the 1978-1979 data. Two kinds of tabulations are included: numerical tabulations that extracted information from the computer-stored data base for the 168 sample buildings; and graphic presentations of the computer-generated data, plus data extracted from other sources. The intent is to provide a single data compendium of key energy-related factors from the 1978 redesign experiment and the associated 1978-1979 ASHRAE Standard 90-75R research. This report also supplements the information for which there was not space in the magazine articles. Thus, for some building types, additional analysis, comments, and data tabulations are included that could not be included in the articles because space was limited. These additional analysis items are not consistent across building types because both the energy conservation opportunities and the design strategies applied by the building designers varied considerably by building type. The chapters have been entered individually into EDB and ERA.

23974 **(VTT-TUTK—28) Development of heat economy and construction of facade elements.** Olin, J.; Ratvio, J.; Jokela, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Feb 1984. 168p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85751474.

The research project is based on energy-saving efforts, which for their part can be carried through reducing e.g. thermal losses through the wall. The need for developing the facade elements was created, moreover, by changes in the house building sector, with a shift in emphasis on small house construction and with requirements for more attractive outward appearance. This research tends to examine the wall structure as an independent structural entity by studying the possibility of developing the wall structure and means of making it competitive. An improved heat economy will also cause changes in other properties of the wall. The properties of the most commonly used insulating materials such as mineral wool, polystyrene and polyurethane, and their possible use as insulation in concrete facade elements are also studied. Along with the traditional mineral wool insulation, the plastics insulations make new applications possible in certain areas, for example, in cases where the thickness of the concrete wythe and the number of wall ties can be reduced by turning to advantage the strength of plastics insulating materials. The interaction between the concrete wythes influences the carrying capacity of the load-bearing facade element. Depending on the wall ties, the interaction between the wythes can be complete, partial or nil. The best carrying capacity is attainable with a complete interaction, which is produced e.g. by the diagonal truss reinforcement used as wall ties. The diagonal reinforcement induces, however, cold bridges and indirect forces between the wythes. Therefore more flexible anchoring methods are recommended when the sufficient carrying capacity is achieved by them.

23975 **(DOE/PE/70411—T1-Pts.1and2) Energy conservation financing for public and not-for-profit institutions; User's guide to CONVEST. Parts 1 and 2.** Graves, K.; Gaynor, W. (Pechan (E.H.) and Associates, Inc., Springfield, VA (USA)). May 1985. Contract AC01-84PE70411. 74p. NTIS, PC $75.00/MF A01 (includes Pts. 1, 2, and diskette). File Number TI85009027.

This report contains detailed case study information on six institutions that have completed Energy Conservation Measures (ECMs). These are: Halmemann Medical College and Hospital; Massachusetts General Hospital; Fulton-DeKalb Hospital Authority; George Washington University; Endicott College; and Augusta College. The second part of this report, "User's Guide to CONVEST", describes alternative forms of financing and serves as documentation for a conservation investment analysis program known as CONVEST, designed to assess the relative merits of alternative means of financing energy conservation projects. CONVEST is an IBM PC or IBM PC-compatible software program. It allows the institution to analyze alternative conservation investment options including third party financing, commercial loans, municipal bonds, government grants, internal financing or any combination. CONVEST analyzes the costs and benefits to each participant in the investment: the institution or first party; the Energy Service Company or second party; and the supplier of capital or third party. A minidisk is included in Part 2 of this report. 8 refs., 6 figs., 12 tabs.

23976 **Connecticut's residential conservation service: an evaluation.** Hirst, E.; Hu, P.S.; Taylor, E.F. Jr.; Thayer, K.M. (Oak Ridge National Lab., TN). *Energy Policy;* **13**: No. 1, 60-70(Feb 1985). Contract W-7405-ENG-26.

CONN SAVE is a non-profit consortium of electric and gas utilities in Connecticut, established to deliver services mandated by the federal Residential Conservation Service. This article describes a quantitative evaluation of the program which involved collection of several types of data from CONN SAVE, fuel suppliers, and households. Data from home energy audits and on-site home interviews were analyzed in terms of conservation potentials as of Spring 1981. Potential for space-heating energy saving was roughly 15% greater in participant homes than in control homes and for water heating energy saving was slightly larger for control homes. Participant homes installed many more retrofit measures than control households and, as a consequence, were expected to cut their

annual energy costs by 2-3 times as much as the control households - 18 MBtu vs 7 MBtu ($160 vs $60). Hence, the CONN SAVE audit was effective in stimulating additional retrofit action on the part of participants. 16 references, 3 figures, 6 tables.

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23977 (CONF-8009327—) Shipboard energy conservation '80. (Society of Naval Architects and Marine Engineers, New York (USA)). 1980. Contract FG01-80CS50190. 402p. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009461.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

Separate abstracts were prepared for individual papers. (MHR)

23978 (CONF-8009327—Suppl.) Shipboard energy conservation '80. Volume II. Discussions and authors' closures. (Society of Naval Architects and Marine Engineers, New York (USA)). 1982. Contract FG01-80CS50190. 97p. Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048. File Number TI84009462.

From Shipboard energy conservation '80 symposium; New York, NY, USA (22 Sep 1980).

23979 (LBL—17591) Method to predict the hour by hour humidity ratio of attic air. Cleary, P.; Sonderegger, R. (Lawrence Berkeley Lab., CA (USA); Morgan Systems, Inc., Berkeley, CA (USA)). Dec 1984. Contract AC03-76SF00098. 22p. (CONF-841202—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009943.

From Symposium on thermal insulation, materials and systems; Dallas, TX, USA (2 Dec 1984).

Long term measurements of attic wood moisture content have shown that at least fifty kilograms of water may be stored in roof sheathing members over the course of the winter, to be released in the spring. Overlaid on this seasonal cycle there is a daily variation driven by temperature changes in the attic. A dynamic model is required to predict the resulting attic air humidity ratio. Hourly moisture flows in a typical attic - from ventilation and from the wood - are examined, and a simple first-principles dynamic mathematical model to relate them is developed. The model predicts the hour-by-hour attic air humidity ratio. Results are compared with measured data. The implications for attic ventilation rates at different levels of attic insulation are discussed. 12 references, 7 figures.

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REFER ALSO TO CITATION(S) 23880, 23927, 23958

23980 (ANL/CNSV-TM—152) Models of unit operations used for solid-waste processing. Savage, G.M.; Glaub, J.C.; Diaz, L.F. (Cal Recovery Systems, Inc., Richmond, CA (USA)). Sep 1984. Contract W-31-109-ENG-38. 229p. NTIS, PC A11/MF A01; GPO Dep. File Number DE85010184.

This report documents the unit operations models that have been developed for typical refuse-derived-fuel (RDF) processing systems. These models, which represent the mass balances, energy requirements, and economics of the unit operations, are derived, where possible, from basic principles. Empiricism has been invoked where a governing theory has yet to be developed. Field test data and manufacturers' information, where available, supplement the analytical development of the models. A literature review has also been included for the purpose of compiling and discussing in one document the available information pertaining to the modeling of front-end unit operations. Separate analytics have been done for each task.

23981 (CONF-810545—) Waste heat management and utilization: proceedings of the third conference. Lee, S.S.; Sengupta, S. (eds.). (Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering). 1981. Contract FG01-78ET13134. 256p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE84009374.

From 3. conference on waste heat management and utilization; Miami, FL, USA (12 May 1981).

Separate abstracts were prepared for individual papers. (MHR)

23982 (CONF-841264—) Black Liquor Research Program symposium: proceedings. Emerson, D.B.; Whitworth, B.A. (Energetics, Inc., Columbia, MD (USA)). Mar 1985. Contract AC01-84CE40716. 177p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85010244.

From Black liquor research program symposium; Washington, DC, USA (12 Dec 1984).

In the paper pulp industry's recovery boilers, black liquor is sprayed in through nozzle guns near the top of the furnace. This report includes eight papers. (DLC)

23983 (DOE/CS/20241—T1) Studies on utilization of municipal solid waste in energy resource recovery projects at refuse fired cogeneration power plants. (Gilbert/Commonwealth, Reading, PA (USA)). [1982]. Contract FG01-79CS20241. 307p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE85010204.

Purpose of the study was to assess the regulatory requirements for the construction and operation of a refuse-fired steam/electric power plant on Navy property at Girard Point. The following are covered in this report: screen environmental requirements; Philadelphia Naval Shipyard market; preliminary site and environmental analysis; base case landfilling analysis; traffic analysis; technology concepts, refuse consumption and steam/electric generation for a facility at Northwest Incinerator and Container Corp., and at Southwest Water Pollution Control Plant; cost summary of five project alternatives and comments on cost comparisons; transportation analysis; and preliminary site analysis. (DLC)

23984 (DOE/CS/40531—T2) Industrial energy productivity handbook. Long, D.J. (comp.). (Mellon Inst., Arlington, VA (USA). Energy Productivity Center). Dec 1981. Contract FG01-81CS40531. 219p. NTIS, PC A10/MF A01; GPO Dep. File Number DE85010811.

This handbook is a compilation of various energy-saving projects in US industry. They are classified according to the industry: food and kindred products; textile mill products; paper and allied products; chemicals and allied products; petroleum refining and related industries; stone, clay, glass, and concrete products; primary metal industries; fabricated metal products; machinery (except electrical); and transportation equipment. (DLC)

23985 (DOE/R3/08061—T1) Fuel conservation for fishing vessels. Final report. (Mid-Atlantic Fisheries Development Foundation, Inc., Annapolis, MD (USA)). Aug 1983. Contract FG43-81R308061. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009485.

The fuel monitoring system provided information that was sufficiently precise and generally reliable enough to be of use in making operational decisions. The curve of fuel consumption versus speed for a vessel will vary with changes in draft, trim, and bottom cleanliness. Therefore, although generalized fuel consumption/speed curves would be of value to an operator, maximum fuel savings can only be effected by applying the actual present fuel consumption, as supplied by a fuel monitor, and true ground speed, as derived by a LORAN C system, to the decision making process. The dividing line between maximum profits and minimum fuel consumption may be a fine line requiring information from a fuel monitor to assist the operator in making the proper decision. This study also addressed the relationship of engine maintenance and fuel monitoring systems.

23986 (MTI—84/TR/4) Technology for industrial waste heat recovery by organic Rankine cycle systems. Final report. Cain, W.G.; Drake, R.L.; Prisco, C.J. (Mechanical Technology, Inc., Latham, NY (USA)). Oct 1984. Contract AC07-82ID12399. 200p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE85006719.

Four different aspects of ORC technology were studied: possible destructive chemical reaction between an aluminum turbine wheel and R-113 working fluid under wheel-to-rotor rub conditions; possible chemical reaction between stainless steel or carbon steel and any of five different ORC working fluids under rotor-stator rub conditions; effects on electric generator properties of extended exposure to an environment of saturated R-113 vapor/fluid; and operational proof tests under laboratory conditions of two 1070 kW, ORC, R-113 hermetic turbogenerator power module systems.

23987 (NP—5770234) Utilization of low-temperature waste heat in horticultural enterprises, pilot project. Pt. 2. Schrottmaier, J.; Nadlinger, M. (Bundesanstalt fuer Landtechnik, Wieselburg (Austria)). Dec 1983. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE85770234.

The pilot project 'utilization of low-temperature waste heat in horticulture', studied the issue of whether or not waste heat of a temperature range between 25 and 30°C may be used for heating greenhouses. The results of the pilot project show that it can be technically feasible and profitable to use waste-heat of this temperature range in horticulture with both vegetables and ornamental plants under glass or foil. Vegetation heating combined with a double-foil greenhouse is particularly suited for vegetable cultivation. Vegetation heating may be installed as an ancillary heating system. In terms of base limit for the horticulturalist, connected outputs of at least 150 W/sqm are to be provided vor vegetable cultivation, and at least 250 W/sqm for ornamental plants. The situation will be improved by far if waste heat of a temperature above 30°C can be supplied.

23988 (NP—5770254) Energy situation and future energy supply of horticultural enterprises in the city of Hamburg. Christian, A.; Zabeltitz, C. von. (Hannover Univ. (Germany, F.R.). Inst. fuer Technik in Gartenbau und Landwirtschaft). 1984. 179p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE85770254.

Profitability studies of very many known heat insulation methods were carried out in the first part of the experts' opinion. The calculation of economic parameters implemented by means of selected model enterprises allows weighting of individual methods. In addition, studies showed that, above all, change-over to alternative and fossil fuels will be profitable only from a certain size of enterprise or a certain energy consumption upwards. Since Hamburg is characterized by small-sized enterprises - in close neighbourhood as a rule - joint-use boiler plants, for instance, were to be planned for ca. 4 to 5 enterprises to each plant.

23989 (VTT-TUTK—257) Energy saving in road paving industry. Lampinen, A.; Karhula, J.; Eerola, M.; Kurki, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)). Feb 1984. 76p. (In Finnish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751476.

This investigation deals with factors affecting the energy consuption at an asphalt mixing plant, in aggregate production and in repaving by heating method. The investigation has been carried out by theoretical calculations, field tests and inquiries. The required energies in making asphalt mixtures and aggregates as well as at the different stages of repaving have been investigated by theoretical calculations. In this way the basis has been found for estimating the energy consumption. The possibility of saving energy in mixing the asphalt is 1.0-1.5 litres of fuel per ton of asphalt for the part of regulating and observing the plant. The savings are approximately the same if the moisture content of the aggregate can be reduced by 1-2 per cent units. The moisture content of aggregates can be influenced in production and in storage. A decrease of one per cent unit of moisture content by means of sheltering covers 5-6 times the costs caused by sheltering. Covering also diminished the problem of freezing. Savings in the repaving method are due to the smaller amount of mass used in comparison with the traditional asphalt pavement. The heating energy needed in repaving is equal to the energy of the tack-coating agent needed in laying a traditional asphalt pavement. Considering the above mentioned factors the energy consumption of a traditional asphalt pavement is 50-100% higher than that of repaving. Technically the repaving method is not always a practical solution.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 23951, 23953, 23954

23990 (BFR-R—47-1984) District heating in a small house district. Measurement of heat losses, assessment of measuring errors and simultaneity factor. Isaksson, T.; Nordstroem, H.; Boij, K.; Dicksson, B.; Maartensson, K.; Sabel, H.; Sundell, J.; Zetterberg, J. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 97p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751423.

Results of measurements in eleven small estates supplied by district heating but limited to the local service and distribution system which are only part of the total network are presented. Heat loss were assessed from measurement of local input heat in relation to the sum of consumed energy at points of use. The difference is explained by leaks measuring faults of meters and used but not measured or invoiced quantities. Some conclusions are: - culvert type and age have a bearing on heat losses, - construction methods are of great importance - optimal dimensioning of systems is of great importance, - regulating equipment at consumer sites are influencing heat losses, - leaking regulating valves lead to heat losses. Several weaknesses in measuring equipment were diagnosed, the weakest link in heat meters were flow meters. Sufficient knowledge of simultaneity factors leads to optimal production programs and culvert dimentions and lay-out and therefore lower investment costs, apart from energy losses. Warm water use is the important factor, heating has no notable influence on this factor. When joining small houses to district heating systems it should be possible to keep heat losses at the local distribution plant under 10 percent per year. Measuring techniques should be improved especially better accuracy at low flow velocities aimed at.

23991 (BFR-R—62-1984) Methods to locate leaks in hot water pipe culverts. Rundstroem, T.; Schleimann-Jensen, A. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 77p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. File Number DE85751428.

Three methods for locating and recording leaks in tubing through culverts are discussed and their merits and weaknesses described in the light of past experience. Electronic alarm systems reacting to moisture above detectable threshold value are still not reliable enough, but have been used in 80 percent of new constructions. Improvements of systems and operation modes are suggested. The acoustic method has limited application but has still a great development potential which is discussed. The thermo camera method using infrared radiation has been very useful in Denmark where its application to the topical problem has been developed for district heating plants. It appears to be most suitable for open air ducts and requires knowledgeable and experienced personnel.

23992 (BFR-R—111-1984) Ground frost problems where district heating culverts cross under roads. Inventory of problems and theoretical analysis. Janson, L.E. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 104p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85751467.

Heat losses from district heating culverts affect ground frost by thaw in surrounding soil leading to up to 20 cm high humps on roads where culverts cross until the time when the frost is breaking up. Even larger height differences were observed during the thaw period. Obviously several drawbacks for both road users and maintenance ensue. Effective insulation of culverts or removal of remaining heat leakage through insulated and ventilated conduits cause, however, new problems through frost penetrating under the culvert with resultant lifting and damage during the frost breaking phase. Another idea is to dissipate excess heat in the sub-soil by ex-

tended layers of polystyrene sheets to neutralize the differences of frost depth above and astride culverts. An investigation based on questionnaires sent to energy suppliers and appropiate communal authorities showed that the problems were serious enough to warrant a closer study and economical acceptabel solution. An analysis lead to a computer based differential calculation method taking regard to all relevant factors. When a practical method is found field trials or/ and laboratory tests are proposed.

23993 **(DOE/CS/20241—T2) Feasibility analysis and conceptual design for the demonstration of energy recovery from municipal waste. Draft.** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Mar 1980. Contract FG01-79CS20241. 152p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85010607.

The overall objective of this study is to establish small-scale solid waste burning as an economically viable and environmentally acceptable means of providing energy requirements for urban area municipal buildings. The specific objective of this study is the development of a conceptual design for a system to supply energy requirements for City Hall, City Hall Annex and the Municipal Services Building utilizing the combustion of available high grade refuse collected from Center City office buildings. This report includes the feasibility analysis and a conceptual design for a 50 ton/day waste to energy recovery plant, employing clean burning incineration technology for the production and supply of steam and electricity to City Hall, City Hall Annex and Municipal Services Building. 15 figs., 5 tabs.

23994 **(PB—85-149490/XAB) Simulated competition as an incentive for utility efficiency.** Masud, E.; Hansen, G.; Nauman, T.; Roop-Claussen, R.; Verkade, M. (Iowa State Commerce Commission, Des Moines (USA). Operations Review Div.). 28 Nov 1983. 147p. NTIS, PC A07/MF A01.

The purpose of the report is to summarize the key elements of incentives in use or proposed for use by utilities, regulators, and researchers; to explain in greater detail the Operations Review Division proposal; and to rebut arguments against the authors proposal. The authors review focuses on incentives that regulators might utilize to make utilities more efficient. They believe that the development of incentives for utility managers is best left to utilities, and therefore such incentives are only briefly examined in this report.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 23913, 23959

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

23995 **(CONF-831142—) Twenty-first automotive technology development contractors' coordination meeting: proceedings.** (Society of Automotive Engineers, Inc., Warrendale, PA (USA)). Mar 1984. 403p. NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE85000072.

From Automotive technology development contractor coordination meeting; Dearborn, MI, USA (13 Nov 1983).

Separate abstracts were prepared for individual papers. (MHR)

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 24199

23996 **(LA—10245-MS) KIVA: a computer program for two- and three-dimensional fluid flows with chemical reactions and fuel sprays.** Amsden, A.A.; Ramshaw, J.D.; O'Rourke, P.J.; Dukowicz, J.K. (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85010334.

This report describes the KIVA computer program, which solves the equations of transient multicomponent chemically reactive fluid dynamics, together with those for the dynamics of an evaporating liquid spray. The program has been developed with applications to internal combustion engines specifically in mind, and contains a number of features to facilitate such applications. However, most of the program structure is quite general, and the program can be adapted to a variety of other applications with only minor modifications. The formulation is fully three-dimensional, but planar and axisymmetric two-dimensional options are also provided. KIVA is a time-marching finite-difference program that uses an acoustic subcycling method for efficiency at low Mach number. Spatial differences are formed with respect to a generalized three-dimensional mesh of arbitrary hexahedrons whose corner locations are specified functions of time. This feature allows a Lagrangian, Eulerian, or mixed description, and is particularly useful for representing curved or moving boundaries. A subgrid scale turbulence model including turbulent energy transport is included, and a turbulent law-of-the-wall boundary layer option is provided. Arbitrary numbers of species and chemical reactions are allowed. The latter are subdivided into kinetic and equilibrium reactions, which are treated by different algorithms. A discrete-particle technique is used to represent an evaporating liquid spray, including the effects of droplet collisions and coalescence. The governing equations, numerical scheme, and program structure are described in detail, and a FORTRAN listing of the program is given in an appendix. 34 references, 19 figures.

23997 **(N—85-12095) High performance fibers for structurally reliable metal and ceramic composites.** Dicarlo, J.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. 16p. (NASA-TM—86878; E—2339; CONF-8406241—1). NTIS, PC A02/MF A01.

From Conference on high performance textiles structures; Philadelphia, PA, USA (6 Jun 1984).

Very few of the commercially available high performance fibers with low densities, high Young's moduli, and high tensile strengths possess all the necessary property requirements for providing either metal matrix composites (MMC) or ceramic matrix composites (CMC) with high structural reliability. These requirements are discussed in general and examples are presented of how these property guidelines are influencing fiber evaluation and improvement studies at NASA aimed at developing structurally reliable MMC and CMC for advanced gas turbine engines.

3304 Hybrid Systems

23998 **(N—85-13245) Evaluation of heat engine for hybrid vehicle application.** Schneider, H.W. (Jet Propulsion Lab., Pasadena, CA (USA)). Aug 1984. 72p. (NASA-CR—174163; JPL-PUB—84-14). NTIS, PC A04/MF A01.

The status of ongoing heat-engine developments, including spark-ignition, compression-ignition, internal-combustion, and external-combustion engines is presented. The potential of engine concepts under consideration for hybrid vehicle use is evaluated, using self-imposed criteria for selection. The deficiencies of the engines currently being evaluated in hybrid vehicles are discussed. Focus is on recent research with two-stroke, rotary, and free-piston engines. It is concluded that these engine concepts have the most promising potential for future application in hybrid vehicles. Recommendations are made for analysis and experimentation to evaluate stop-start and transient emission behavior of recommended engine concepts.

3306 Vehicle Design Factors

23999 **(N—85-13241) A.A.D. engine noise evaluation. Final report.** (Institute of Sound and Vibration Research, Southampton (UK)). Dec 1983. 29p. NTIS, PC A16/MF A01.

In Cummins Engine Co., Inc., Advance Automotive Diesel Assessment Program, 29p, (N—85-13235 04 37).

A critique of the various characteristics of engine design influencing noise and attempts to indicator areas where attention is required to obtain noise acceptable engine for automobiles are dis-

cussed. It was concluded that the engine has a potential to be quiet because a ion rated speed is chosen. Problems with high gas pressure, the fuel injection pump, and the expander/compressor are discussed.

24000 **Holistic approach to vehicle simulation.** Hooker, J.N.; Rose, A.B.; Roberts, G.F. (Oak Ridge National Lab., TN). *Mathematics and Computers in Simulation;* **25**: 259-267(1983).

Vehicle simulators traditionally model a vehicle's components separately. This paper describes a holistic simulator that constructs a map of fuel consumption vs speed, acceleration, and gear for the vehicle as a whole, based on statistical analysis of road test data. A single computer routine can simulate any number of existing vehicles, once each is outfitted with instruments and a data logger and is tested 1 to 2 days on the road and perhaps on a chassis dynamometer. Results of simulating a 1979 Ford Fairmont station wagon are presented. 12 references, 8 figures, 1 table.

36 MATERIALS

REFER ALSO TO CITATION(S) 23830

24001 **(LA-UR—85-1062) Crystal growth from the vapor in low gravity environments.** Santandrea, R.P. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 10p. (CONF-850357—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009628.

From Spring national meeting of AIChE; Houston, TX, USA (24 Mar 1985).

Effects of earth's gravity on fluids and gases are discussed. Crystal growth in microgravity has been studied since the first Skylab mission. Crystal growth from the vapor has been accomplished in space using the chemical vapor transport method, and the principles behind this method and the results obtained in space are discussed, particularly in the germanium chalcogenide systems. Chemical vapor deposition in space offer promising applications. (DLC)

24002 **(UCID—20355-85-1) Vacuum Processes Group progress report, November 1984-January 1985.** Sanders, D.M.; Romo, J.G. (Lawrence Livermore National Lab., CA (USA)). 28 Feb 1985. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010044.

Within this reporting period, the Vacuum Processes Group has successfully responded to the requirements placed upon it by the Programs. It has supplied all coatings required for upcoming events, all requested vacuum engineering support, and all required vacuum braze joints in a timely manner. In addition, the Group has developed new technology, particularly in the coatings area, to increase future offerings to the Laboratory. Finally, efforts have been initiated which will greatly increase the ability of the group to respond to future programmatic needs.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 23453, 23455, 23462, 23498, 23500, 23546, 23569, 23569, 23779, 23780, 23787, 23788, 23789, 23790, 23793, 23793, 23810, 23811, 24093, 24233, 24239, 24838, 25027, 25029, 25037

24003 **(BNL—35988) vuv synchrotron light as a technique for studying the interface quality and properties of thin overlayers.** Ruckman, M.W.; Murgai, V.; Strongin, M. (Brookhaven National Lab., Upton, NY (USA)). Dec 1984. Contract AC02-76CH00016. 7p. (CONF-841157—88). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009822.

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

The measurements presented here show the value of synchrotron light for determining both the electronic structure of overlayers, and the physical nature of the overlayer-substrate interface. A comparison is given between deposited layers and thermally stabilized layers. Estimates are also made of the bonding energy between the overlayer and substrate.

24004 **(CONF-850169—3) Determination of the vacancy formation enthalpy in chromium by positron annihilation.** Loper, G.D.; Smedskjaer, L.C.; Chason, M.K.; Siegel, R.W. (Argonne National Lab., IL (USA)). Jan 1985. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010286.

From 7. international conference on positron annihilation; New Delhi, India (6 Jan 1985).

Doppler broadening of the positron annihilation lineshape in 99.99 at. % pure chromium was measured over the temperature range 296 to 2049°K. The chromium sample was encapsulated in sapphire owing to its high vapor pressure near melting. Saturation-like behavior of the lineshape was observed near the melting temperature (2130°K). A two-state trapping model fit to the data yielded a vacancy formation enthalpy of 2.0 +- 0.2 eV. This result is discussed in relation to extant empirical relations for vacancy migration and self-diffusion in metals and to data from previous self-diffusion and annealing experiments in chromium. It is concluded that the observed vacancy ensemble is unlikely to be responsible for the measured self-diffusion behavior. The implications of the present results in terms of our understanding of mechanisms for self-diffusion in chromium and other refractory bcc metals are discussed.

24005 **(CONF-850169—6) Theory of positron annihilation in vacancies in concentrated disordered alloys.** Prasad, R.; Benedek, R.; Bansil, A. (Argonne National Lab., IL (USA); Northeastern Univ., Boston, MA (USA). Dept. of Physics). Jan 1985. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010267.

From 7. international conference on positron annihilation; New Delhi, India (6 Jan 1985).

A theory of the two-photon momentum density for positrons trapped in vacancies in concentrated substitutional binary alloys has been developed within the framework of the KKR-CPA method. Our ultimate objective is to obtain information regarding the local environment of vacancies in alloys by comparison of predicted momentum distributions with the results of 2D-ACAR experiments. The theory is formulated in terms of muffin-tin wavefunctions and real-space path operators for the electrons and the vacancy-trapped positron. Partial results are presented for a vacancy in pure Cu.

24006 **(CONF-850310—46) Self-sustaining coatings for fusion applications - copper lithium alloys.** Krauss, A.R.; Gruen, D.M.; Brooks, J.N.; Mendelsohn, M.H.; Mattas, R.F.; DeWald, A.B. (Argonne National Lab., IL (USA); Georgia Inst. of Tech., Atlanta (USA)). 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009740.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Auger electron spectroscopy has been used to monitor the surface composition of an alloy consisting of 3.0 at. % Li in Cu while sputtering with 1 to 3 keV Ar^+ or He^+ at a flux of 10^{13} to 10^{14} cm^{-2} sec^{-1} (corresponding to a gross erosion rate of several mm/yr) at temperatures up to 430°C. It is found that the alloy is capable of reproducibly maintaining a complete lithium overlayer. The time-dependent thickness of the overlayer depends strongly on the mass and energy spectrum of the incident particle flux. It has been experimentally demonstrated that a significant fraction of the sputtered lithium is in the form Li^+ and is returned to the surface by an electric field such as the sheath potential at the limiter, or a tangential magnetic field such as the toroidal field at the first wall; consequently, the overlayer lifetime is essentially unlimited. The TRIM computer code has been used to calculate the sputtering yield for pure metals and the partial sputtering yields of binary alloy components for various assumed solute concentration profiles.

24007 **(CONF-850351—6) Influence of particle erosion on the microstructural changes in metals and alloys.** Moteff, J.; Rosa, E. (Cincinnati Univ., OH (USA). Dept. of Materials Science and Metallurgical Engineering). 1985. 8p. American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017. File Number TI85901384.

From 30. international gas turbine conference and exhibit; Houston, TX, USA (18 Mar 1985).

ASME Paper 85-GT-201.

The microstructural changes that occur in metals and alloys exposed to pneumatic particle erosion conditions are determined through microhardness measurements performed on the cross-section of the target material. In particular, the hardness gradient in an inward direction normal to the eroded surface is determined for pure Cu, AISI 304 stainless steel, and for AISI 1020 steel having various degrees of cold-work. The elevated temperature erosion behavior of Ti-6A1-4V as a function of the elevated temperature surface microhardness and ductility clearly shows significant differences when evaluated above and below about one-half of the absolute melting temperature of this alloy. 12 figs.

24008 (CONF-850573—1) **Opticals constant at x-ray wavelengths.** Smith, D.Y.; Williamson, A.E.; Morrison, T.I. (Argonne National Lab., IL (USA)). Jan 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009743.

From Topical conference on basic properties of optical materials; Gaithersburg, MD, USA (7 May 1985).

Preliminary results are reported for the optical constants of the common elements at x-ray wavelengths as derived from absorption spectra using dispersion theory-sum rule analysis. 14 refs., 3 figs.

24009 (DOE/ER—0046/18, pp 143-148) **Microstructures and physical properties of Cu-Zr and Cu-Cr-Zr-Mg alloys.** Zinkle, S.J.; Plantz, D.H.; Kulcinski, G.L.; Dodd, R.A. (Univ. of Wisconsin, Madison). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

Electrical resistivity measurements have been made at 20°C on specimens of as-received AMZIRC and AMAX-MZC copper alloys as a function of annealing time and temperature. The electrical conductivity of both alloys steadily increases between 300 and 550°C. The maximum conductivity is about 90% IACS for MZC and ~ 100% IACS for AMZIRC. TEM observations indicate that AMZIRC contains incoherent Cu-Zr precipitates which are preferentially located at grain boundaries. The AMAX-MZC alloy contains the same Cu-Zr precipitates, and also coherent Cr precipitates which are uniformly distributed throughout the matrix.

24010 (DOE/ER—0046/18, pp 35-60) **Fundamental flow and fracture studies of HT-9.** Odette, G.R.; Lucas, G.E.; Maiti, R.; Sheckherd, J.W. (Univ. of California, Santa Barbara). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

Results of electron microscopy studies of cleavage crack formation and propagation in HT-9 are consistent with a model for stress-controlled cleavage in which the critical stress σ/sub f//sup */ is related to the lath packet size. Moreover, σ/sub f//sup */ appears to undergo a sharp transition at low temperatures and high strain rates; this is probably a result of a change in mechanism from slip- to twinning-nucleated cleavage. This change in σ/sub f//sup */ effects corresponding changes in lower shelf fracture toughness. A simple two-parameter approach is shown to be a reasonable basis for predicting fracture loads for various size and crack-geometry bend specimens. These results indicated that cleavage fracture will occur near plastic collapse loads for thin wall structures containing shallow surface cracks. Results of an initial study of ductility in the cleavage regime indicate deflectional displacements on the order of 1-2 cm/m will be the limit for such shallow surface cracks in thin walls. The effects of dissolved hydrogen and stress state variations induced by side grooving were investigated. Hydrogen charges resulted in an average reduction in measured K/sub O/ values of about 17% and 5% in the ratio of maximum load fracture-to-collapse stress ratios. No significant effect of hydrogen on ductility was observed. Side grooving resulted in increases in both apparent K/sub O/ toughness levels and fracture-to-collapse stress ratios. Side grooving decreased ductility for shallow cracks and increased it for deep cracks. In general these effects are judged to be relatively modest compared to uncertainties in the measurements and the effects of significant variations in size and strength levels.

24011 (DOE/ER—0046/18, pp 5-10) **Dosimetry measurements and damage calculations for the ORR-MFE4B experiment.** Greenwood, L.R.; Smither, R.K. (Argonne National Lab., IL). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

Dosimetry measurements and damage calculations are reported for the MFE4B spectral-tailoring experiment in the ORR. With an exposure of 424 full power days the maximum fluence was 1.9×10^{22} n/cm^2 producing about 64 appm helium and 5.1 dpa in 316 stainless steel. The status of all other experiments is summarized.

24012 (DOE/ER—0046/18, pp 18-20) **Helium generation measurements for Ti and Cu from ORR.** Oliver, B.M.; Kneff, D.W.; Skowronski, R.P. Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

Helium generation measurements have been made for Ti and Cu samples irradiated in the Oak Ridge Research Reactor (ORR) experiment MFE4A2. The results are significantly different from helium generation predictions based on ENDF/B-V cross section evaluations, providing evidence that the ENDF/B-V files for helium generation in Ti and Cu require revision for fission reactor neutron spectra. Similar discrepancies have previously been observed in analyses of samples irradiated in the Experimental Breeder Reactor-II (EBR-II). Measurements were also made using platinum-encapsulated samples to test helium retention in Ti, Cu, and Fe in the severe ORR irradiation environment. Preliminary results show less than 1% loss from iron, but losses of ~3.5% and ~6% from Ti and Cu, respectively.

24013 (DOE/ER—0046/18, pp 26-28) **Effects of substitutional alloying elements in an Fe-10Cr ferritic alloy.** Gelles, D.S.; Beem, W.L. (Hanford Engineering Development Lab., Richland, WA). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

The object of this effort is to determine the effects of substitutional alloying elements in an Fe-100Cr base composition on microstructural development due to neutron irradiation. The alloying elements selected are of interest in reduced activation applications and include a wide range of atom sizes. In order to determine the effect of minor element additions on microstructural development due to fast neutron irradiation, a series of 12 alloys has been prepared for irradiation in MOTA 1C. The alloy series involves additions of Si, Mn, V, W, Ta, and Zr to form alloys of Fe-10Cr-0.1M and Fe-10Cr-1M (where M designates the alloying addition).

24014 (DOE/ER—0046/18, pp 30-34) **Relating bubble size to the failure mode of neutron- and helium-irradiated austenitic stainless steel.** Gerke, R.D.; Jesser, W.A. (Univ. of Virginia, Charlottesville). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

Helium irradiated type 316 microtensile specimens containing tiny bubbles were tensile tested at 250°C and 450°C under rapid and slow strain rates. Mixed mode failure occurred under all conditions suggesting strain rate insensitive microstructures are possible. These results support previous work suggesting that dynamic interaction between clusters of helium and dislocations occur at high temperatures to finely distribute helium-vacancy clusters at the grain boundary and initiate intergranular failure. These results show that it is also possible to establish a fine distribution of tiny bubbles by cold injection of helium and thereby cause intergranular failure at low temperatures (<450°C).

24015 (DOE/ER—0046/18, pp 61-70) **Some considerations of radiation effects on stress corrosion cracking of fusion reactor materials.** Jones, R.H. (Pacific Northwest Lab., Richland, WA). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

The purpose of this evaluation was to identify potential synergisms between irradiation phenomena and stress corrosion processes. There have been few studies on the stress corrosion behavior of irradiated material and no reported studies of in-situ stress corrosion. Therefore, an assessment of potential irradiation and stress corrosion synergisms was undertaken to identify possible concerns for fusion reactor materials. Published research on radiation enhanced corrosion was reviewed and it was concluded that radiolysis is not expected to increase the corrosion rate of fusion reactor materials by more than a factor of 3; however, hydrogen uptake could increase significantly in ferritic, refractory and reactive alloys. The effect of irradiation enhanced creep on intergranular stress corrosion cracking, IGSCC, was modeled and it was concluded that irradiation creep could significantly increase the crack growth rate at stresses below the yield strength. A phosphorus segregation induced IGSCC process was also evaluated and shown that radiation induced phosphorus segregation could dominate all other IGSCC effects. Calculated K/sub IC/ and K/sub TH/ results for HT-9 were reviewed and compared with published K/sub IC/ results from the ADIP program. This comparison suggests that the model used to calculate the effects of increasing yield strength and grain boundary segregation on K/sub IC/ gives calculated values significantly less than the experimental results.

24016 (DOE/ER—0046/18, pp 71-80) **Strength and microstructure in vanadium irradiated with T(d,n) neutrons at 300K, 475K, and 675K.** Bradley, E.R. (Pacific Northwest Lab., Richland, WA). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

Tensile test and microstructural examinations have been conducted on vanadium wires and foils containing 1300 wt-ppm interstitial impurities following T(d,n) neutron irradiation at 300K, 475K, and 675K. Tensile results from wire samples show similar increases in yield strength for samples irradiated at 300K and 475K but strengthening decreased significantly following irradiation at 675K. SEM examination of the fracture surfaces showed all samples failed by ductile rupture after attaining more than 95% reduction in area. A reasonable correlation between microstructures and strengthening was obtained using a simple dispersed barrier strengthening model. A high density of extremely small (< nm diam.) defect clusters was responsible for the observed strengthening after irradiation at 300K. Following irradiation at 475K, interstitial loops with a<100> Burgers vectors were the predominant strengthening defect with a smaller contribution from a/2<111> type loops. A heterogeneous distribution of dislocation loops and planar precipitates prevented definite correlations between strength and microstructure in samples irradiated at 675K from being made.

24017 (DOE/ER—0046/18, pp 82-85) **Correlation of irradiated 20% CW 316 stainless steel fracture toughness with test temperature.** Simons, R.L.; Hamilton, M.L. (Hanford Engineering Development Lab., Richland, WA). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

A three parameter function was developed to correlate fracture toughness (J/sub Ic/ in 20% CW 316 SS as a function of test temperature. The equation is applicable for the exposure range 40 to 60 dpa, irradiation temperature range 643 to 680°K, and test temperature range 293 to 923°K.

24018 (DOE/ER—0046/18, pp 86-97) **Comparison of depth-dependent microstructures of ion-irradiated 316-type stainless steels.** Sindelar, R.L.; Dodd, R.A.; Kulcinski, G.L. (Univ. of Wisconsin, Madison). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

The microstructural response of P7, a high-swelling, pure 316-type stainless steel and the MFE heat of 316 stainless steel were investigated after 14-MeV Ni-ion irradiation. Specimens of the P7 alloy were irradiated to fluences of 3.3 x 10^{16} 14-MeV Ni ions/cm^2. Irradiation temperatures ranged from 500°C to 650°C (0.45 - 0.6 T/sub m/). In addition, a sample of 316 SS was irradiated at 650°C (0.6 T/sub m/) to a fluence of 3.3 x 10^{16} 14-MeV Ni ions/cm^2. The irradiated specimens were examined in cross-section by electron microscopy. The 500°C irradiation of the P7 alloy produced a depth-dependent void distribution influenced by the excess interstitial effect of the bombarding ions. The 650°C irradiations of the P7 alloy produced a bi-modal void distribution at the damage peak. The 650°C irradiation of 316 SS produced needle-like precipitation in the entire damage region.

24019 (DOE/ER—0046/18, pp 98-106) **Microsegregation observed in Fe-35.5Ni-7.5Cr irradiated in EBR-II.** Brager, H.R.; Garner, F.A. (Hanford Engineering Development Lab., Richland, WA). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

At 593°C one alloy, Fe-35.5Ni-7.5Cr, which was particularly resistant to swelling in EBR-II, increased in density 0.9% at 7.6 x 10^{22} n/cm^2 (E > 0.1 MeV). Examination by energy dispersive x-ray analysis revealed that substantial oscillations occur in the nickel content of the alloy, varying from 25 to 53% about the nominal level of 35.5%. These oscillations exhibit a period of ~200 nm. Regions enriched in nickel are depleted in chromium and iron, and the reverse is true in regions of low nickel content. This spinodal-like process produces a net densification and also appears to eventually destroy the swelling resistance of the alloy. Once voids form in the nickel-poor chromium-rich regions, further segregation of nickel to void surfaces is expected to accelerate the loss of swelling resistance.

24020 (DOE/ER—0046/18, pp 107-121) **Experimental investigation of the effect of injected interstitials on void formation.** Badger, B. Jr.; Plumton, D.L.; Zinkle, S.J.; Sindelar, R.L.; Kulcinski, G.L.; Dodd, R.A.; Wolfer, W.G. (Univ. of Wisconsin, Madison). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

Pure nickel, a pure 316-type stainless steel (P7) and two high strength copper alloys have been irradiated with either 14-MeV nickel or copper ions to a peak damage level of 50 dpa (K = 0.8) at homologous temperatures ranging from 0.4 to 0.6 Tm. The irradiated foils have been examined in cross section in an electron microscope. The injected interstitial effect on the suppression of the measured void densities in Ni and P7 was found to increase with decreasing temperature. The comparison of these results with nucleation theory shows good qualitative agreement. Quantitative discrepancies are attributed to diffusional spreading of point defects and to the presence of impurity atoms in the matrix. A copper alloy irradiated at 300°C showed a small heterogeneous void density characteristic of the high temperature end of the void swelling regime, while no voids formed in the alloys irradiated > 400°C. This result is in excellent agreement with nucleation theory which indicates the void swelling regime in ion-irradiated, low impurity copper should be less than 300°C (0.42 Tm).

24021 (DOE/ER—0046/18, pp 149-154) **Microstructure of high-strength, high-conductivity copper alloys irradiated at low temperatures.** Zinkle, S.J.; Kulcinski, G.L.; Dodd, R.A. (Univ. of Wisconsin, Madison). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

Preliminary results have been obtained on the effects of ion irradiation on two high-strength copper alloys at temperatures 100-250°C. Both the AMZIRC and the AMAX-MZC alloy exhibit radiation-enhanced recovery and partial recrystallization at all temperatures following irradiation to a peak damage level of 15 dpa (K = 0.3). A high density of black spots has been observed for all irradiation conditions. There is no observable void formation in either

of the as-received alloys following ion irradiation to 15 dpa (K = 0.3) at temperatures 100-550°C.

24022 (DOE/ER/03935—92) Study of alloy strengthening due to atomic order. Final report, May 1, 1969-April 30, 1983. Marcinkowski, M.J. (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). 1983. Contract AS05-76ER03935. 12p. (ORO—3935-92). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010338.

Ordered alloys show a high work hardening rate and enormous strengthening, owing to a large increase in dislocation density within the alloys. These alloys are mostly brittle, with the brittleness often being confined to the grain boundaries. It was found that any distortion could be described in terms of a continuous array of surface dislocations of infinitesimal strength. By using the surface dislocation concept, the theory of fracture could cover the entire range from fully brittle to fully ductile crack nucleation and propagation. It was shown that all grain boundaries are composed of lattice dislocations, but that much of their stress fields is annulled due to surface dislocations. The brittle behavior of ordered alloys can be attributed to the grain boundaries providing a high-energy path for crack propagation. (DLC)

24023 (DOE/ER/10430—T2) Hydrogen absorption in metals: a field ion microscopy study. Final report, June 1, 1981-December 31, 1984. Pickering, H.W. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). Mar 1985. Contract AC02-79ER10430. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85010299.

The high-performance atom-probe was successfully constructed and satisfactory performance was obtained with a mass resolution of $m/\Delta m \sim 1000$ and the detection efficiency close to the theoretical upper limit. In the case of Fe-Ti alloys, we have documented surface segregation of Ti and also observed internal and external oxidation of this binary alloy depending upon O_2 partial pressure. We have studied a Fe-0.04% P alloy to observe grain boundary segregation of P at high temperatures (>300°C). Phosphorus however, was not found in the carbide precipitate, presumably being rejected during its formation. Another new (and surprising) observation is that surface segregation exhibits cross-over in Cu-Ni alloys at 16% Ni concentrations.

24024 (DOE/ER/45113—1) Magnetic impurities in superconductors. Progress report, July 1, 1984-June 30, 1985. Ruvalds, J. (Virginia Univ., Charlottesville (USA). Dept. of Physics). 1985. Contract FG05-84ER45113. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008372.

The progress of the following studies is reported: (1) susceptibility and order parameter for a superconductor with coupled magnetic impurities, (2) resistivity from magnetic impurity pairs in metallic alloys, (3) critical field of a superconductor containing magnetic impurities, (4) dynamics of charge density waves, and (5) dynamics of spin density waves in the presence of impurities. (BCS)

24025 (IFUSP-P—426) Hyperfine field at Ge in Fe. Hrynkiewicz, A.; Acquadro, J.C.; Cybulska, E.W.; Rao, M.N.; Ribas, R.V.; Seale, W.A.; Wylie, W.R. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700503.

The results of a remeasurement of the hyperfine magnetic field at ^{67}Ge in an iron host are reported.

24026 (IFUSP-P—441) Hyperfine field at Na in Fe. Hrynkiewicz, A.; Ribas, R.V.; Rao, M.N.; Cybulska, E.W.; Seale, W.A.; Acquadro, J.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700507.

The results of Time Dependent Pertubed Angular Correlation (TDPAC) measurements for ^{22}Na recoil nuclei implanted into magnetized iron are reported.

24027 (INIS-mf—9501) Flux pinning by voids in surface-oxidized superconducting niobium and vanadium. Meij, G.P. van der. (Rijksuniversiteit Leiden (Netherlands)). 16 May 1984. 152p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780833.

Includes Dutch summary.

This thesis describes a study of flux pinning by small voids (roughly 10 nm) in the type II superconductors niobium and vanadium. These voids were created in rectangular foils (with typical dimensions of 30x3x0.2 mm) during an irradiation with fast neutrons in the High Flux Reactor at Petten at temperatures between 400 and 1000°C. The pinning force per unit volume is determined from the magnetic properties of the superconducting samples. The experiments were carried out in a slowly ramped magnetic field, as well as in a combination of a static and a much smaller alternating field.

24028 (JAERI-M—83-138) Study of creep and rupture behavior for Hastelloy alloy XR. Evaluation of the creep data for structural design at elevated temperatures. Yokoi, Shin; Monma, Yoshio; Kondo, Tatsuo; Ogawa, Yutaka; Kurata, Yuji. (Japan Atomic Energy Research Inst., Tokyo). Sep 1983. 126p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. File Number DE85700885.

Creep tests of Hastelloy alloy XR (a modified Hastelloy alloy X developed for VHTR application) were carried out at 800, 900 and 1000°C up to 310,000 hours in total testing times. The effects of environment (air and simulated VHTR helium), specimen diameters, product forms of the material (tube, plate and bar) and the neutron irradiation were also investigated. The ASME allowable stresses (Ssub(o), Ssub(m), and Ssub(t) in Code Case N-47) required to establish the design limit on the primary system were calculated using the current data. A procedure was developed to calculate equations which represented lower limits of the prediction intervals and the simultaneous tolerance intervals of strength on the basis of regression analysis. Statistical analysis of the three time-temperature parameter methods showed that the Manson-Succop method was better than that of either Larson-Miller or Orr-Sherby-Dorn in respect of curve fitting to the present creep-rupture data. Application of the Garofalo equation to the strain-time data resulted in a creep constitutive equation (tentative version) which represented the average isochronous stress-strain curves. It was recognized that there was little difference between air and helium in the creep-rupture strength up to about 10,000 hours. In helium environment there appeared slight indication that carburization occured in the early stage of exposure but no further carbon intrusion was observed in the steady state creep range. Comparison of creep behaviors among three product forms of the same heat indicated that the bar had superior creep-strength to the tube. This was attributed to the banded precipitation of carbides in the tube. As a result of significant ductility loss due to the neutron irradiation up to 8.7 x 10^{20}n/cm^2(th) at 60°C, the rupture times reduced below about 20% that of the unirradiated one.

24029 (KEK—83-18) Gas desorption and photo-electron production from aluminum exposed to synchrotron radiation. Groebner, O.; Tomose, T.; Mizuno, H.; Kobayashi, M.; Kanazawa, K.; Horikoshi, G.; Narushima, K.; Ishimaru, H. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Oct 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700887.

A photon induced desorption measurement was applied to an ordinary extruded aluminium using synchrotron radiation light in the Photon Factory. The synchrotron light beam with a cross section of 5 x 5 mm^2 was perpendicularly introduced onto the sample surface. The critical photon energy was 4 keV. A typical photon flux was 10^{17} photons.s^{-1}.cm^{-2}. The photo-electron yields for the surface were in the range from 2.6 to 3.3 x 10^{-2} electrons per photon. The initial desorption yields have been found to be 2 – 4 x 10^{-2} for H_2, 3 – 6 x 10^{-3} for CO and 1 – 4 x 10^{-3} for CO_2, and very small for both H_2O and CH_4. It was found that the desorption yield is inversely proportional to the total photon dose. The dose necessary to reduce the initial desorption yield by a factor of 10 is found to be the order of 4 x 10^{18} photons.cm^{-2} (1.2 x 10^{-2} mA.h.cm^{-2}).

24030 **(PNL-SA—12315) Crack tip chemistry modeling of intergranular stress corrosion cracks of nickel containing segregated phosphorus and sulphur.** Danielson, M.J.; Oster, C.A.; Jones, R.H. (Pacific Northwest Labs., Richland, WA (USA)). Nov 1984. Contract AC06-76RL01830. 44p. (CONF-8410207—2). NTIS, PC A03/MF A01; GPO Dep. File Number DE85010059.

From Conference on corrosion chemistry within pits, crevices and cracks; Teddington, UK (1 Oct 1984).

The effect of P and S on the intergranular corrosion and stress corrosion of Ni has been evaluated with corrosion tests, crack tip corrosion modeling and stress corrosion tests. Tests were conducted in 1N H_2SO_4 at 25°C over anodic potentials of +- 0.3V to 2.OV (SEC). A one-dimensional mass transport model (considering diffusion, migration, and nickel sulphate precipitation) was successfully developed to predict the corrosion rates at the tip and crack walls. Corrosion tests were conducted on Ni + P and Ni + S alloys and Ni samples ion implanted with P and S to develop a data base for the model. The corrosion results showed that both P and S reduce passivity in Ni and enhance the corrosion rate but that P is oxidized and dissolves in the electrolyte while S remains on the surface. The model predicts that the active tip and crack walls with Ni + S will result in precipitation of $NiSO_4$ at very shallow crack depths and extremely low crack tip corrosion rates. Both IGC and IDCC are essentially absent from the Ni + S system at 900 mV (SEC). The model predicts much larger crack tip corrosion rates for the Ni + P system with an active tip and passive walls.

24031 **(SAND—82-2338) Study of intermediate velocity penetration of steel spheres into deep aluminum targets.** Trucano, T.G.; Grady, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010419.

We report the results of an experimental, analytical and computational effort focused on identifying the effects and significance of adiabatic shear band formation in metal penetration phenomena. In the experiments performed, a hardened steel sphere impacted targets of 6061-T6 aluminum. The impact velocity varied from 0.6 to 1.2 km/s, while targets were large enough to be treated as infinite half-spaces in the analyses. Depth of penetration and target microstructure were observed after each experiment, and compared with the results of quasistatic punch tests performed on identical targets. Shear bands were observed in the targets for the dynamic experiments, but were absent in the quasistatic tests. Work-of-penetration differences were also noted between quasistatic and high-velocity tests. Analyses performed indicate that thermal softening and/or thermal shear localization does strongly influence the dynamic penetration process. Calculations which do not explicitly account for thermal softening mechanisms fail to predict the observed depths of penetration. However, we have found that the importance of thermal softening and/or thermal shear localization is not as significant as previously reported.

24032 **(SAND—84-2146) Plasma arc welding, equipment, installation, and process control.** Fuerschbach, P.W. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85008481.

The plasma arc welding (PAW) process can achieve the highest power density of all the conventional arc welding processes and has advantages over laser beam welding (LBW) and electron beam welding (EBW). Power density is an independent variable which can be precisely controlled. The combination of high orifice gas flowrates and arc current pulsation increases weld penetration for thin section partial penetration PAW welds. Unfortunately, the PAW process has not reached its full potential because of equipment deficiencies. Contaminants (i.e., oxygen, water vapor) in the orifice gas system are important for stable operation of the pilot arc as is the concentric alignment of the electrode within the nozzle bore. Due to a refractory oxide skin, high heat input is necessary to weld aluminum with conventional arc processes. LBW has not proven practical. Low current ac PAW with 0.035 in. thick aluminum produced small welds with good depth-to-width ratio.

24033 **(SAND—84-8710) Micromechanism of fracture for stage I hydrogen-induced crack growth.** Moody, N.R.; Stoltz, R.E.; Perra, M.W. (Sandia National Labs., Livermore, CA (USA)). Apr 1985. Contract AC04-76DR00789. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010027.

Definition of the micromechanism of fracture for stage I crack growth, and therefore threshold and the stage I/II transition, is of particular importance since this stage of crack growth is stress controlled instead of hydrogen transport controlled as often observed for stage II crack growth. Examination of hydrogen-induced crack growth data shows an average ratio of 1.38 exists between the stage I/II transition stress intensity (K/sub I/II/) and threshold (K/sub Th/). A quantitative model based on the stress intensity required for fracture nucleation along a single grain boundary, K/sub n/, and grain boundary orientation within the fracture process zone predicts the distribution of K/sub I/II//K/sub Th/ values in agreement with experimental data. The model shows that the fracture process zone size at the state I/II transition is twice that at threshold. Furthermore, it provides a basis for describing stage I crack growth in terms of the amount of fracture within the process zone. During stage I growth, the stresses are insufficient for fracture over two process zones (a prerequisite for crack advance). This is accomplished by an increase in the amount of fracture which shifts the stress distribution into the sample and promotes additional fracture within the process zone.

24034 **(SKI-B—24-80) Determination of nitrogen in pressure vessel steels. Final report of SKI project B24/80.** Danielsson, L.; Oestberg, G. (Swedish Nuclear Power Inspectorate, Stockholm). [1980]. 8p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700886.

Free nitrogen in pressure vessel steel might cause embrittlement through dynamic strain aging. Steels from 7 nuclear reactors have been analyzed. In most of the 19 samples sufficient nitrogen was present for this kind of embrittlement.

24035 **(UCID—20329) Evaluation of 7XXX-series aluminum alloys for the W87 aft support ring.** Mahin, K.W. (Lawrence Livermore National Lab., CA (USA)). 1 Mar 1985. Contract W-7405-ENG-48. 59p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85009987.

The study showed that the tensile properties of both 7075-T6 and 7050-T73651 decreased significantly after holding the alloys for any length of time at temperatures greater than 500°F. After a 2-min hold at 575°F, the yield strengths of 7075-T6 and 7050-T73651 were 217 MPa (31.5 ksi) and 245 MPa (35.6 ksi), respectively. There did not appear to be a significant difference in the mechanical properties between 7075-T6 and 7050-T6. Time at temperature appeared to be a critical parameter. Cycling the microstructure to 575°F or above with no hold at temperature caused considerably less degradation in mechanical properties than a 2-min hold at temperature in all cases. Above 650°F, both the ultimate tensile strength and the yield strength of the alloys reached a minimum of around 310 MPa (45 ksi) and 138 MPa (20 ksi), respectively. Evidence of a continuous grain boundary film of eta phase precipitates was found in the 7075-T6 alloy after a typical 575°F thermal cycle. The presence of this grain boundary precipitate indicated a potential sensitivity of this alloy to stress corrosion cracking. Although the general environment for the aft support ring is controlled, the ring is expected to be under tension after assembly and exposure to small amounts of water vapor will probably occur. The conditions of stress, moisture, and susceptible microstructure increase the likelihood of stress corrosion cracking.

24036 **(UCRL—91779) Resolvability of defect ensembles with positron annihilation studies.** Fluss, M.J.; Howell, R.H.; Rosenberg, I.J.; Meyer, P. (Lawrence Livermore National Lab., CA (USA)). 12 Nov 1984. Contract W-7405-ENG-48. 8p. (CONF-841157—89). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010041.

From Materials Research Society annual meeting; Boston, MA, USA (26 Nov 1984).

Recent advances in the use of positron annihilation to study defect ensembles in and on the surfaces of metals, are pointing the way towards studies where particular positron-electron annihilation

modes may be identified and studied in the presence of one another. Although a great deal is understood about the annihilation of positrons in ostensibly defect-free metals, much less is understood when the positron annihilates in complex defect systems such as liquid metals, amorphous solids, or at or near the vacuum-solid interface. In this paper the results of three experiments, all of which demonstrate means by which we can resolve various poistron annihilation channels from one another, are discussed.

24037 **(UCRL—92289) Resolvability of positron decay channels.** Fluss, M.J.; Howell, R.H.; Rosenberg, I.J.; Meyer, P. (Lawrence Livermore National Lab., CA (USA)). 7 Mar 1985. Contract W-7405-ENG-48. 5p. (CONF-850169—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85008958.

From 7. international conference on positron annihilation; New Delhi, India (6 Jan 1985).

Many data analysis treatments of positron experiments attempt to resolve two or more positron decay or exist channels which may be open simultaneously. Examples of the need to employ such treatments of the experimental results can be found in the resolution of the constituents of a defect ensemble, or in the analysis of the complex spectra which arise from the interaction of slow positrons at or near the surfaces of solids. Experimental one- and two-dimensional angular correlation of annihilation radiation experiments in Al single crystals have shown that two defect species (mono- and divacancies) can be resolved under suitable conditions. Recent experiments at LLNL indicate that there are a variety of complex exit channels open to positrons interacting at surfaces, and ultimely these decay channels must also be suitably resolved from one another. 6 refs., 4 figs.

24038 **(UUIP—1115) Critical behaviour of ^{19}F hyperfine fields in Ni near the Curie temperature.** Ekwall, B.; Johansson, K.; Lidbjoerk, P.; Lindgren, B.; Aggarwal, N.; Bedi, S. (Uppsala Univ. (Sweden). Inst. of Physics). Apr 1984. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700825.

The temperature dependence of the magnetic hyperfine fields for ^{19}F in Ni has been studied between 550 K and 640 K, with the TDPAD method. The critical exponents β, σ and γ were determined. Beam heatup effects are also discussed.

24039 **(UUIP—1116) Magnetic vacancies; simulations and TDPAD experiments with ^{19}F in Al(x) Fe(1-x).** Ekwall, B.; Johansson, K.; Lidbjoerk, P.; Lindgren, B.; Norlin, L.O. (Uppsala Univ. (Sweden). Inst. of Physics). Apr 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700826.

Al(x) Fe(1-x) alloys with less or equal 4.2 at percent have been studied by the TDPAD method utilising ^{19}F as probe. The hyperfine field was found to increase with 0.39(6) percent per at percent Al. A Monte Carlo simulation of the dipolar distribution, due to the missing Fe moments, agrees well with the experimental results.

24040 **(UUIP—1117) Hyperfine field on ^{19}F in Fe above 500 K.** Ekwall, B.; Johansson, K.; Lidbjoerk, P.; Lindgren, B. (Uppsala Univ. (Sweden). Inst. of Physics). Apr 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700827.

The local fields on Fluorine 19 in iron were measured at temperatures between 540 K and 700 K using the TDPAD method. At these temperatures signals from a second local field position appears, with a field lower than the one normally attributed to a substitutional position. This field is attributed to fluorine atoms having a vacancy as nearest neighbour, with an activation energy of 1.1(2)eV.

24041 **(UUIP—1118) Hyperfine fields on ^{19}F in Dy, Gd and Tb.** Ekwall, B.; Johansson, K.; Lidbjoerk, P.; Lindgren, B. (Uppsala Univ. (Sweden). Inst. of Physics). Apr 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700828.

The internal fields on ^{19}F in the rare earth elements Gd, Tb and Dy were measured at approximately 20 K with the TDPAD method. The experimental internal fields were: 1.844(6) T (Gd), 1.59(1) T and 1.14(1) T (Dy).

24042 **(UUIP—1119) Hyperfine field on ^{19}Ne in Fe.** Ekwall, B.; Johansson, K.; Lidbjoerk, P.; Lindgren, B.; Bedi, S. (Uppsala Univ. (Sweden). Inst. of Physics). Apr 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700829.

The hyperfine field on ^{19}Ne in iron was measured with the TDPAD method. At 77 K the ^{19}Ne hyperfine field in iron was found to be -4.48(7) T. The temperature dependence of the hyperfine field in iron was studied between 77 K and 650 K. It was not possible to observe any hyperfine field on ^{19}Ne in nickel, using the same method.

24043 **Comment on "The elastic stiffness coefficients of nickel-iron single-crystal alloys at room temperature".** Ledbetter, H.M. (Fracture and Deformation Division, Center for Materials Science, National Bureau of Standards, Boulder, Colorado 80303). *Journal of Applied Physics;* **57**: No. 11, 5069-5070(1 Jun 1985).

We respond to the recent claim that in face-centered-cubic Fe-Ni alloys the two cubic elastic-shear coefficients, C_{44} and $(C_{11}-C_{12})/2$, vary linearly with composition. Both theory and measurement support a nonlinear variation.

24044 **Flexible A-15 superconducting tape via the amorphous state.** Clapp, M.T.; Shi, D. (Department of Mechanical Engineering, University of Massachusetts, Amherst, Massachusetts 01003). *Journal of Applied Physics;* **57**: No. 10, 4672-4677(15 May 1985). Contract AC02-80ER10566.

The melt spinning technique was used to rapidly solidify superconducting materials. In the $Ti_3Nb_5Mo_2Si_4$ alloy system, it was possible to form metastable A-15 and amorphous ribbons as the quenching rate was increased. The liquid-quenched A-15 ribbons were extremely brittle, which is typical of this crystal structure. The metastable A-15 phase could also be formed by annealing the amorphous ribbons. These, however, were far more flexible, their percent elongation being up to 30 times greater than that of the liquid quenched A-15's. The flexibility appeared to depend on grain size, and increased as the grain size decreased. This is consistent with behavior observed in other brittle materials of a brittle to ductile transition as a function of grain size.

24045 **Measurements of the magnetic excitations above T/sub c/ in iron and nickel (invited).** Mook, H.A.; Lynn, J.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **57**: No. 8, 3006-3011(15 Apr 1985). Contract AC05-84OR21400.

High-resolution neutron scattering measurements, utilizing full polarization analysis techniques, have been carried out to explore the nature of the magnetic response above T/sub c/ in these itinerant ferromagnets. Large isotopically enriched single crystals were employed in order to obtain reliable determinations of the scattering function S(q,E). The scattering in Ni is found to evolve in a continuous fashion from the well-known spin diffusion response at small wave vectors q to a response with peaks centered at +- E at larger q, in agreement with our original work. The ratio of the observed widths of these spin waves to the spin-wave energies, as determined directly from measurements at constant q, is found to decrease with increasing 'q' as expected. We also show that the recent measurements by Shirane and collaborators were taken with resolution which was too coarse to observe these spin-wave excitations.

24046 **Paramagnetic form factors from itinerant electron theory.** Cooke, J.F.; Liu, S.H.; Liu, A.J. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **57**: No. 8, 3027-3029(15 Apr 1985). Contract AC05-84OR21400.

Elastic neutron scattering experiments performed over the past two decades have provided accurate information about the magnetic form factors of paramagnetic transition metals. These measurements have traditionally been analyzed in terms of an atomic-like theory. There are, however, some cases where this pro-

cedure does not work, and there remains the overall conceptual problem of using an atomistic theory for systems where the unpaired-spin electrons are itinerant. We have recently developed computer codes for efficiently evaluating the induced magnetic form factors of fcc and bcc itinerant electron paramagnets. Results for the orbital and spin contributions have been obtained for Cr, Nb, V, Mo, Pd, and Rh based on local density bands. By using calculated spin enhancement parameters, we find reasonable agreement between theory and neutron form factor data. In addition, these zero parameter calculations yield predictions for the bulk susceptibility on an absolute scale which are in reasonable agreement with experiment in all treated cases except palladium.

24047 **Proton NMR and susceptibility measurements in TiCoH/sub x/.** Bowman, R.C. Jr.; Craft, B.D.; Tadlock, W.E.; Venturini, E.L.; Cantrell, J.S. (Monsanto Research Corporation-Mound, Miamisburg, Ohio 45342). *Journal of Applied Physics;* **57**: No. 8, 3036-3038(15 Apr 1985). Contract AC04-76DP00053.

The proton spin-lattice relaxation times (T_1) and magnetic susceptibilities (chi) are used to study the effects of hydrogen on the electronic structure properties of the intermetallic compound TiCo. Hydrogen addition systematically decreases both chi(T) and the proton $(T_1T)^{-1}$/sup //^{2} parameters, which are directly proportional to the local density of the Fermi-level electronic states. The behavior for the TiCoH/sub x/ is completely opposite to that previously found for several other Ti-based metal hydrides where these parameters tend to increase with hydrogen content. These differences are attributed to the Fermi levels falling on alternate sides of peaks in the densities of electronic states. The present results for TiCoH/sub x/ are compared with the magnetic properties and the theoretical band structures for the closely related hydride TiFeH/sub x/.

24048 **Upper critical magnetic field of the superconducting heavy fermion system (U/sub 1-x/ Th/sub x/)Be_{13}.** Chen, J.W.; Lambert, S.E.; Maple, M.B.; Naughton, M.J.; Brooks, J.S.; Fisk, Z.; Smith, J.L.; Ott, H.R. (Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92093). *Journal of Applied Physics;* **57**: No. 8, 3076-3078(15 Apr 1985). Contract AT03-76ER70227.

Measurements of the ac electrical resistance as a function of temperature and applied magnetic field R(T,H) were made for various compositions x < or ≈0.03 in the mixed binary system (U/sub 1-x/Th/sub x/)Be_{13}. All samples within this range of x exhibit heavy Fermion superconductivity with a superconducting transition temperature T/sub c/ that is rapidly suppressed by the substitution of Th for U. The shape of the upper critical field curve H/sub c/ 2(T) determined from the R(T,H) data is similar for all compositions with a very large initial slope (-dH/sub c/2/dT)/sub T//sub c/.

24049 **Superconductivity and normal-state electronic properties of URu_3 and UCo: New behavior for U-compound superconductors.** Chen, J.W.; Hake, R.R.; Lambert, S.E.; Maple, M.B.; Rossel, C.; Torikachvili, M.S.; Yang, K.N. (Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92093). *Journal of Applied Physics;* **57**: No. 8, 3090-3092(15 Apr 1985). Contract AT03-76ER70227.

The compound URu_3 has been found to exhibit superconductivity below 0.15 K. Polycrystalline specimens of URu_3 and two other U-compound superconductors, UPt_3 and UCo, have been investigated by means of ac magnetic susceptibility measurements in zero and finite magnetic fields. Electrical resistivity, dc magnetic susceptibility, and specific-heat measurements on URu_3 and UCo reveal non-heavy-fermion behavior for both compounds and evidence for relatively large exchange enhancement of the Pauli paramagnetic susceptibility for UCo.

24050 **Low temperature resistivity of Ce-La-Th under pressure.** Lawrence, J.M.; Thompson, J.D.; Fisk, Z.; Batlogg, B. (Center for Materials Science, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **57**: No. 8, 3131-3133(15 Apr 1985).

The low temperature resistivity of Ce/sub 0.9-x/La/sub x/ Th/sub 0.1/ alloys is known to vary as $rho_0 + \alpha T^2$. We have investigated the variation of rho_0 and α with pressure for several concentrations x. An unusually strong nonlinear decrease of the residual resistivity with pressure occurs; the magnitude of the decrease is an order-of-magnitude larger than in the isostructural nonmagnetic alloy La/sub 0.8/Th/sub 0.2/. The temperature coefficient α(P) also decreases strongly. These results are in qualitative accord with recent theories of the resistivity of disordered valence fluctuation compounds.

24051 **Low temperature properties of $CeOs_2$ in the C14 and C15 crystallographic Laves phases.** Torikachvili, M.S.; Yang, K.N.; Maple, M.B.; Meisner, G.P. (Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92093). *Journal of Applied Physics;* **57**: No. 8, 3137-3139(15 Apr 1985). Contract AT03-76ER70227.

The compound $CeOs_2$ has been prepared in both cubic C15 and hexagonal C14 Laves phases. Measurements of ac and dc magnetic susceptibility, electrical resistivity, and specific heat have been performed on samples of both phases. The C14 phase has been found to exhibit superconductivity with a superconducting transition temperature T/sub c/ of 1.1 K, while the C15 phase does not display superconductivity above 70 mK. The curves of resistivity vs temperature for both phases exhibit strong negative curvature which are reminiscent of valence fluctuation compounds.

24052 **Induced Fe and Co moments in rare earths and uranium compounds.** Burzo, E. (Central Institute of Physics, P.O. Box 5206 Bucharest, Romania). *Journal of Applied Physics;* **57**: No. 8, 3232-3234(15 Apr 1985).

The results of magnetic measurements performed on (Gd/sub x/Y/sub 1-x/)$_2Fe_{14}B$ compounds, in the temperature range 4.2 K and 1000 K are firstly reported. Then, the molecular field coefficients characterizing the magnetic interactions inside and between magnetic sublattices, as well as the exchange fields acting on the Fe atoms are determined. The variations of the mean iron momrnts, as compared to x = 0 value, are linear dependent on those of the exchange fields. Similar behavior is observed for TM = Fe or Co in (Gd/sub x/Y/sub 1-x/)TM/sub m/, Gd(TM/sub y/Al/sub 1-y/)/sub m/ and U(Fe/sub x/TM/sub 1-x/')$_2$ compounds with TM' = Co, Mn, Ni, or Al and m = 2, 3, and 3.5. The composition dependence of TM moments in the above systems is mainly attributed to the variation of the exchange interactions.

24053 **Specific heat of GdRh.** Azhar, A.A.; Mitescu, C.D.; Johanson, W.R.; Zimm, C.B.; Barclay, J.A. (Department of Physics and Astronomy, Pomona College, Claremont, California 91711). *Journal of Applied Physics;* **57**: No. 8, 3235-3237(15 Apr 1985).

GdRh, a ferromagnetic intermetallic, is of interest as a working material for magnetic refrigeration. The requirements for such materials have been discussed by Barclay et al. and it is in this context that we analyze our data. Magnetic measurements of Buschow et al. have indicated T/sub C/ = 24 K while specific heat measurements of Olijhoek et al. have shown a maximum at 20 K and have yielded a magnetic entropy of 16.7 J/mole K. No Debye temperature has been reported previously. We have measured the specific heat from 1.8 to 77 K and our data show a peak at 19.93 K that is 17% higher than in the previous work. Fitting of the data from 40 to 77 K to $C = A/T^2 + D(T/\theta\{T\})$, where A and $\theta\{T\}$ are adjustable parameters and D is the Debye function, yields a Debye temperature of 198 +- 2 K. For the magnetic entropy we obtain 17.4 J/K, very close to R ln 8.

24054 **Magnetic and Moessbauer studies on $GdCo_3B_2$ and $DyCo_3B_2$.** Malik, S.K.; Umarji, A.M.; Shenoy, G.K. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **57**: No. 8, 3252-3254(15 Apr 1985).

Magnetization and Moessbauer studies have been carried out on $GdCo_3B_2$ and $DyCo_3B_2$. These compounds are magnetically ordered with Curie temperatures of 56 and 21 K, respectively. The Co atoms are either nonmagnetic or carry a small moment in these

compounds. The saturation moment of $DyCo_3B_2$ at 5 K is smaller than the Dy^{3+} free-ion value. From ^{161}Dy Moessbauer studies, the measured hyperfine magnetic field at the Dy site is also observed to be smaller than the free-ion value. ^{155}Gd Moessbauer measurements in $GdCo_3B_2$ reveal the presence of large crystalline electric fields at the rare-earth site. This causes the moment and the hyperfine field at the Dy site in $DyCo_3B_2$ to be reduced from its free-ion value.

24055 **Investigation of Metglas toroid fabrication techniques for a heavy ion fusion driver.** Faltens, A.; Rosenblum, S.S.; Smith, C.H. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* 57: No. 8, 3508-3510(15 Apr 1985). Contract AC03-76SF00098.

Measurements are reported on the dc and pulsed magnetic properties of three Metglasa) alloys in the as-cast, box annealed, and rewound conditions. Alloys 2605SC, 2605S-2 and 2605CO were evaluated for possible use in an induction linear accelerator. It is found that the 2605SC and 2605S-2 give similar good performance and the 2605CO slightly less good performance in this application in the microsecond pulse-width region.

24056 **Effects of hydrogen on magnetic properties of amorphous zirconium alloys.** Venturini, E.L.; Bowman, R.C. Jr.; Cantrell, J.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* 57: No. 8, 3542-3544(15 Apr 1985).

The magnetic susceptibilities chi(T) of the amorphous ternary hydrides of the paramagnetic metallic glasses a-Zr_3Pd and a-Zr_3Rh have been measured between 7 and 300 K. It has been found that chi(T) of both a-Zr_3PdH/sub x/ and a-Zr_3RhH/sub x/ decrease substantially with increasing hydrogen content. This behavior is primarily attributed to reductions in the densities of the Fermi level electronic states. Although chi(T) for crystalline Zr_3Pd ($MoSi_2$ structure type) is smaller than the susceptibility of the a-Zr_3Pd glass, chi(T) for a crystallized Zr_3Rh sample was found to increase relative to the initial susceptibility for this glass.

24057 **Theoretical determination of surface magnetism (invited).** Weinert, M.; Freeman, A.J.; Ohnishi, S.; Davenport, J.W. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* 57: No. 8, 3641-3645(15 Apr 1985). Contract AC02-76CH00016.

The theoretical determination of the magnetic structure of surfaces within the (local) spin-density formalism is briefly described. The feasibility of using such methods for determining delicate magnetic quantities is illustrated by calculation of (1) the Knight shift of the paramagnetic Pt(001) surface, (2) the magnetization of the clean and Ag-covered Fe(001) surface, and (3) the effect of a p(1 x 1) H overlayer on the magnetization of a Ni(001) surface. These results demonstrate that it is possible not only to make quantitative predictions for real systems, but more importantly, to gain insight into the underlying physics at surfaces.

24058 **Magnetization of very thin Ni films in epitaxial metal film sandwiches of Cu.** Sill, L.R.; Brodsky, M.B.; Bowen, S.; Hamaker, H.C. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439 and Northern Illinois University, DeKalb, Illinois 60115). *Journal of Applied Physics;* 57: No. 8, 3663-3665(15 Apr 1985). Contract W-31-109-ENG-38.

Single-crystal nickel films varying in thickness from 2-40 A were prepared by epitaxial growth between thicker layers (500 A) of single-crystal copper (001). Their magnetization was measured as a function of field up to 10 kOe using a dc SQUID magnetometer. The saturation magnetization of these films was determined as a function of Ni thickness at liquid helium temperatures. A decrease in saturation moment from that of bulk nickel was observed for films of thickness less than 18 A. The apparent Curie temperature also decreases with decreasing thickness for these films. The magnetization at maximum field as a function of temperature does not follow a Brillouin function.

24059 **Magnetic form factor of 5f electrons in PuSb.** Lander, G.H.; Delapalme, A.; Brown, P.J.; Spirlet, J.C.; Rebizant, J.; Vogt, O. (Institut Laue-Langevin, Grenoble, France and Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* 57: No. 8, 3748-3750(15 Apr 1985). Contract W-31-109-ENG-38.

The magnetic form factor of the 5f electrons around the Pu nucleus has been measured with neutrons. The experiment used polarized neutrons and a single crystal of weight 55 mg of PuSb. This compound, which has the NaCl crystal structure, is ferromagnetic below 67 K. The experiment was done in the ordered state with an applied field of 46 kOe. The results show that the Pu ion is trivalent; we see the maximum in f(Q) at $Q \simeq 2.5$ A^{-1}, which is the unambiguous signature of the $5f^5$ state. A detailed analysis shows that the ground-state wave function is close to that of a Γ_8 state in intermediate coupling. The analysis makes use of the large azimuthal anisotropy (variation in magnetic scattering depending on the angle the scattering vector makes with the magnetic moment) and is not consistent with any possible Γ_7 state.

24060 **Polarized neutron measurement of "forbidden" magnon scattering in Pt_3Mn.** Li, W.; Perry, C.H.; Sokoloff, J.B.; Lynn, J.W.; Nicklow, R.M. (Northeastern University, Boston, Massachusetts 02115). *Journal of Applied Physics;* 57: No. 8, 3751-3752(15 Apr 1985). Contract AC05-84OR21400.

We have employed inelastic scattering of polarized neutrons to study the nature of the magnetic response in the vicinity of the Curie temperature (T/sub C/ = 493 K) for the intermetallic ferromagnet Pt_3Mn. The measurements were taken on the HB-1 triple-axis spectrometer at ORNL, with a field of 10 kOe applied along the scattering vector Q. For 0.9T/sub C/ < T < 1.2T/sub C/ we observed underdamped magnons not only with the conventional (+) spin-wave polarization but also with the "forbidden" (-) polarization, with an intensity difference I(+)-I(-) which is approximately proportional to the magnetization. Both these observations are in agreement with the slowly fluctuating spin-density theory of itinerant ferromagnetism.

24061 **Magnetic excitation in CuMn spin glass alloy.** Tsunoda, Y.; Kunitomi, N.; Cable, J.W. (Osaka University, Osaka, 560 Japan). *Journal of Applied Physics;* 57: No. 8, 3753-3755(15 Apr 1985). Contract AC05-84OR21400.

The spin dynamics of a spin glass alloy Cu/sub 78.7/Mn/sub 21.3/ have been studied by neutron inelastic scattering. Measurements have been made at 20, 150, and 290 K by the constant E mode of operation. Magnetic excitations with rather large energy transfer have been observed around the (1 1/2 0) and the (1 1/2 +- δ 0) magnetic diffuse peak positions above and below the spin freezing temperature (T/sub f/~90 K). The results indicate the existence of strong space and time correlations of the spins over the temperature range of the measurements. The experimental data are well explained by a model of dynamically fluctuating spin clusters with a broad distribution of relaxation times.

24062 **Nuclear spin ordering observed by neutron diffraction (invited).** Nicklow, R.M.; Moon, R.M.; Kawarazaki, S.; Kunitomi, N.; Suzuki, H.; Ohtsuka, T.; Morii, Y. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* 57: No. 8, 3784-3788(15 Apr 1985). Contract AC05-84OR21400.

A review is given of recent neutron scattering experiments which have been carried out at milli-Kelvin temperatures to study the hyperfine-enhanced nuclear-spin ordering in the singlet electronic ground state compounds $PrSn_3$, $PrCu_6$, and $HoVO_4$. Bragg peaks were observed in $PrSn_3$ which are due solely to the nuclear spin polarization of ^{141}Pr caused by the hyperfine field from the antiferromagnetically ordered electronic moment. The temperature dependencies of the nuclear polarization and the additional electronic polarization induced by the nuclear polarization have been measured in detail. A magnetic phase transition in $PrCu_6$ which is believed to correspond to a simultaneous ordering of both the nuclear and electronic spin systems has been observed at 58 mK. The positions of the magnetic diffraction peaks in reciprocal space are represented by G +- tau, where G is a vector of the reciprocal lattice and tau = $0.24a^*$ +- $0.68c^*$, indicating that the magnetic peri-

odicity is incommensurate with the chemical lattice. In $HoVO_4$ magnetic diffraction peaks due to the antiferromagnetic ordering of the nuclear spin system were observed below 4.5 mK. The observed magnetic structure and the dependence of the neutron diffraction intensities on magnetic field are consistent with the predictions of Bleaney on the basis of dipolar energy considerations.

24063 **Investigation of magnetism at surfaces by polarized neutron reflection (invited).** Felcher, G.P.; Felici, R.; Kampwirth, R.T.; Gray, K.E. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **57**: No. 8, 3789-3794(15 Apr 1985).

It is shown that the spin-dependent reflectivity of a cold neutron beam from magnetically active surfaces, measured as a function of the neutron wavelength, can provide the magnetic depth profile of the material. Following the construction of a prototype instrument at the Intense Pulsed Neutron Source at Argonne, studies were made of the magnetic disturbances at the surface of superconductors. The results obtained, and discussed here, pertain to the penetration depth in a superconductor (niobium and lead) below the critical flux entry field H/sub c/1, and the surface superconductivity of an incipient type II superconductor (lead-bismuth alloy) below H/sub c/3. The prospects for this technique, with particular regard to the study of the surface critical phenomena of ferromagnets, are also discussed.

24064 **Self-consistent electronic structure of disordered Fe/sub 0.65/Ni/sub 0.35/.** Johnson, D.D.; Pinski, F.J.; Stocks, G.M. (Department of Physics, University of Cincinnati, Cincinnati, Ohio 45221). *Journal of Applied Physics;* **57**: No. 8, 3018-3020(15 Apr 1985). Contract AC05-84OR21400.

We present the results of the first ab initio calculation of the electronic structure of the disordered alloy Fe/sub 0.65/Ni/sub 0.35/. The calculation is based on the multiple-scattering coherent-potential approach (KKR-CPA) and is fully self-consistent and spin polarized. Magnetic effects are included within local-spin-density functional theory using the exchange-correlation function of Vosko—Wilk—Nusair. The most striking feature of the calculation is that electrons of different spins experience different degrees of disorder. The minority spin electrons see a very large disorder, whereas the majority spin electrons see little disorder. Consequently, the minority spin density of states is smooth compared to the very structured majority spin density of states. This difference is due to a subtle balance between exchange splitting and charge neutrality.

24065 **Chemisorption of H on magnetic Ni(001).** Weinert, M.; Davenport, J.W. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **54**: No. 14, 1547-1550(8 Apr 1985). Contract AC02-76CH00016.

A theoretical investigation of an ordered p(1 x 1) H overlayer on Ni(001) shows a marked reduction of the surface Ni moment to $\sim 0.2\mu$/sub B/ (which at room temperature gives the impression of a "dead" layer) and the formation of a covalent-metallic bond between H and Ni. These results, along with the calculated equilibrium properties and single-particle spectrum, are discussed and compared to experiment.

24066 **Rippled relaxation in the (110) surface of the ordered metallic alloy NiAl.** Davis, H.L.; Noonan, J.R. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **54**: No. 6, 566-569(11 Feb 1985). Contract AC05-84OR21400.

Results from a LEED analysis of NiAl(110) demonstrate that it possesses a large rippled relaxation away from its hypothethical truncated bulk surface, with the Al sites of the top composite Ni-Al layer being displaced approximately 0.22 A above the Ni sites. The evidence for this rippling is strong, since the agreement achieved between calculated and experimental I-V profiles is of the same quality obtained in better LEED analyses of monatomic surfaces.

24067 **Low temperature structural distortion in the high Tsub(c) chevrel-phase superconductors $PbMo_6S_8$ and $SnMo_6S_8$.** Jorgensen, J.D.; Hinks, D.G. (Argonne National Lab., IL (USA)). *Solid State Communications;* **53**: No. 3, 289-292(Jan 1985).

High-resolution powder neutron diffraction data reveal that, at temperatures below 100 K, oxygen-free, high-Tsub(c) samples of $PbMo_6S_8$ and $SnMo_6S_8$ exhibit a small structural distortion from the R3 rhombohedral space group. The data cannot be refined in a simple P1 triclinic space group as previously reported for $EuMo_6S_8$ and $BaMo_6S_8$. Thus, a supercell ordering is suggested.

24068 **Trapping of oxygen by zirconium in dilute niobium-zirconium alloys.** Lengeler, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung); Pick, M.A. (Brookhaven National Lab., Upton, NY (USA)). *Solid State Communications;* **53**: No. 3, 297-299(Jan 1985).

It has been shown by X-ray absorption spectroscopy that oxygen is trapped by Zr in dilute NbZr alloys. Oxygen occupies the nearest octahedral sites next to a Zr atom. There is one O atom trapped by each Zr atom. The angular information needed for the exact location of the O is obtained from a "lens" effect in the EXAFS which is observed when the O shadows a Nb back-scatterer. At 1075°C and below there is no precipitation of zirconium oxides in Nb.

24069 **Temperature fields produced by traveling distributed heat sources.** Eagar, T.W.; Tsai, N.S. (Massachusetts Institute of Technology, Cambridge). *Welding Research Supplement;* 346s-355s(Dec 1983). (CONF-830485—). Contract AC02-78ER04799.

From 64. annual American Welding Society meeting; Philadelphia, PA, USA (24 Apr 1983).

The solution of a traveling distributed heat source on a semi-infinite plate provides information about both the size and the shape of arc weld pools. The results indicate that both welding process variables (current, arc length and travel speed) and material parameters (thermal diffusivity) have significant effects on weld shape. The theoretical predictions are compared with experimental results on carbon steels, stainless steel, titanium and aluminum with good agreement. 25 references, 23 figures, 1 table.

24070 **Systematics of the enthalpy and volume of solution of hydrogen in transition metals.** Welch, D.O.; Pick, M.A. (Brookhaven National Lab., Upton, NY). *Physics Letters [Section] A;* **99**: No. 4, 183-186(28 Nov 1983). Contract AC02-76CH00016.

The enthalpy and volume of hydrogen solution in transition metals can be systematized by approximating the solution energy as the sum of an electronic bonding term, the same for all metals and essentially equal to the chemisorption energy, and a deformation energy, approximated by a simple elastic continuum model. 15 references, 2 figures.

24071 **Surface-active element effects on the shape of GTA, laser, and electron-beam welds.** Heiple, C.R.; Roper, J.R.; Stagner, R.T.; Aden, R.J. (Rockwell International Energy Systems Group, Golden, CO). *Welding Research Supplement;* 72.s-77.s(Mar 1983).

Laser and electron-beam welds were passed across selenium-doped zones in 21-6-9 stainless steel. The depth/width (d/w) ratio of a defocused laser weld with a weld pool shape similar to a GTA weld increased by over 200% in a zone where 66 ppm selenium had been added. Smaller increases were observed in selenium-doped zones for a moderately defocused electron beam weld with a higher d/w ratio in undoped base metal. When laser or electron beam weld penetration was by a keyhole mechanism, no change in d/w ratio occurred in selenium-doped zones. The results confirm the surface-tension-driven fluid-flow model for the effect of minor elements on GTA weld pool shape. Other experimental evidence bearing on the effect of minor elements on GTA weld penetration is summarized.

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24072 Positron annihilation in Al single crystals from 85 mK to 300 K. Schultz, P.J.; Vehanen, A.; Thomlinson, W.; Lynn, K.G.; MacKenzie, I.K. (Brookhaven National Lab., Upton, NY). *Journal of Physics F: Metal Physics;* **13**: 265-268(1983). Contract AC02-76CH00016.

Doppler-broadening and positron lifetime data were taken for well annealed ultra-pure Al(110) crystals from 85 mK to 300 K. The Doppler-broadening data are independent of specimen temperature from 85 mK to 77 K, while they show an increase between 77 K and 300 K consistent with the linear slope observed previously by Hood and Schultz. Over the whole temperature range studied, the Doppler data scale to the static thermal expansion coefficient. The lifetime data also show no obvious dependence on temperature over the entire range studied, although they were statistically limited by the cryostat geometry. These results, which represent the lowest temperatures studied by any positron-annihilation technique, provide no evidence for positron localization at low temperatures in very well annealed single crystals. 16 references, 1 figure.

24073 Metallography of microwelds by microtoming. Cramer, J.J.; Turner, J.; Gustin, C.S. (Mound Facility, Miamisburg, OH). *Microstructural Science;* **11**: 275-282(1983). Contract AC04-76DP00053.

Metallography of microwelds is a complex process requiring long sample-preparation time and extra care. A diamond-bladed microtome similar to the type used for slotting of production parts was adapted for metallography of laser welds of one-mil wire. Sample preparation and analysis of the welds can be completed in approximately 15-20 min as opposed to the minimum of 3 hr required by the standard metallographic technique of mounting, grinding, and polishing. Surface of the metals produced by microtoming prior to etching are superior and have less deformed metal than surfaces produced by the standard metallographic techniques. The metallography of microwelds by microtoming resulted in improved surfaces in less time. 3 references, 6 figures, 1 table.

24074 Hydrogen attack of bainitic 2 1/4 Cr-1 Mo steel. Woods, C.M.; Scott, T.E. (Mound Facility, Miamisburg, OH). *Microstructural Science;* **11**: 466-479(1983). Contract AC04-76DP00053.

Smooth-bar and notched-bar tensile specimens of normalized and tempered (bainitic) 2 1/4 Cr-1 Mo steel were exposed to hydrogen gas at 5.2 to 27.6 Mpa in the temperature range from 482 to 593C. Polished and etched surfaces as well as fracture surfaces obtained by fracturing the samples at liquid nitrogen temperature were examined for methane bubble formation in the scanning electron microscope (SEM). Tensile tests were performed at room temperature on exposed samples. The formation of bubbles was found to be sensitive to changes in both the temperature and hydrogen pressure for any given exposure time. Applied stress, plastic deformation and longer exposure times all lowered the temperature necessary, at any given pressure, for the formation of bubbles. 18 references, 10 figures, 2 tables.

24075 Helium migration and its influence on cavity formation in irradiated materials. Ghoniem, N.M. (Univ. of California, Los Angeles). *Res Mechanica;* **6**: 1-8, 22-23(1983). Contract AM03-76SF00034.

The introduction of helium atoms in irradiated structural materials is now recognized to impair their useful properties. In this paper, the author outlines the theoretical foundations for the mechanisms of helium transport and subsequent clustering in irradiated alloys. Under typical reactor irradiations, helium is trapped in vacancies or vacancy complexes, and then detrapped by a variety of thermal and displacement mechanisms. The effective helium diffusion rate is described, in view of the influence of material and irradiation variables. Cavity formation and stability are then presented, with emphasis on the theoretical understanding of nucleation mechanisms. 24 references.

24076 Macroscopic optical model for the ellipsometry of an underpotential deposit: lead on copper and silver. Muller, R.H.; Farmer, J.C. (Lawrence Berkeley Lab., CA). *Surface Science;* **135**: 521-531(1983). Contract AC03-76SF00098.

Sub-monolayers of underpotential deposits of Pb on Ag and Cu substrates have been investigated in situ by ellipsometry during cyclic voltammetry. Predictions based upon two extrapolated macroscopic optical film models were compared to measurements. An island film model, in which film growth is assumed to occur by the spreading of monolayer film patches, provided good agreement with measurements. In this model, the state of polarization of reflected light is determined by the coherent superposition of polarization states resulting from reflection on adjacent film-covered and bare surface elements. Fractional surface coverage and optical constants of the deposit, the independent variables in the model, were determined by multidimensional optimization over the entire range of coverage and confidence intervals for the parameters were determined by statistical analysis of the measurements. 17 references, 5 figures, 1 table.

24077 Specimen material reversal in pin-on-disc tribotesting. Rice, S.L.; Wayne, S.F.; Nowotny, H. (Univ. of Connecticut, Storrs). *Wear;* **88**: 85-92(1983). Contract AC02-81ER10910.

Results from pin-on-disc wear tests in which specimen and counterface materials were interchanged are presented. In one set of tests, pins of material A were slid against discs of material B; then, in another set of tests, pins of material B were slid against discs of material A. There are many factors to consider in such experiments, including the fact that the pin experiences a greater sliding distance and presumably higher near-surface temperatures. However, tests results from such specimen material reversals are useful in studying the roles of thermal, mechanical and chemical processes in sliding wear and also in assessing the validity of tribotesting against a standard counterface material. The results reported include data on volume change (obtained from weight change measurements), on war track profiles, on subsurface zone morphology and composition and on debris composition. As expected, these data indicate that significantly different results will be obtained for a given pin-on-disc test for pin material A against disc material B compared with pin B against disc A.

24078 Role of microstructure in the wear of selected steels. Wayne, S.F.; Rice, S.L.; Minakawa, K.; Nowotny, H. (Univ. of Connecticut, Storrs). *Wear;* **85**: 93-106(1983). Contract AC02-81ER10910.

This investigation is a continuation of impact wear studies which focus on the nature of subsurface microstructure. Both AISI 1045 and 2.25Cr-1Mo steels were selected for their capacity to form various phase morphologies at given compositional states. Heat treatment was then performed to produce the desired two-phase (duplex) structure in both materials. The mating counterface to each test material was a 17-4 PH stainless steel in the martensitic condition. Compound impact wear tests were performed at relative transverse sliding velocities of 1 and 10 m s^{-1} with peak nominal contact stress maintained at 69 MPa for various numbers of repetitive load cycles. The formation and characterization of subsurface zones were studied by scanning electron microscopy and energy-dispersive X-ray analysis. Wear debris was inspected by powder X-ray diffraction. The impact wear resistance of AISI 1045 and 2.25 Cr-1Mo steels is dependent on transverse velocity. Variations in velocity lead to trade offs between specimen and counterface 17-4 PH stainless steel wear which is evidenced in weight loss data and correlates with microstructural observations (subsurface zone formation) for each two-phase system. Wear debris analysis confirms the presence of mechanochemical material interaction between specimen and counterface with increasing transformation and oxidation at the higher transverse sliding velocity.

24079 AES study of the reaction of oxygen with T-111 (Ta-8W-2Hf). David, D.J.; Snide, J.A.; Moddeman, W.E. (Univ. of Dayton, OH). *Applications of Surface Science;* **13**: 329-351(1982).

Reactions of oxygen with T-111, the kinetics of the reaction, the role of hafnium, and the rate-controlling step of such reactions at elevated temperatures were evaluated using polished and etched specimens whose surfaces were monitored from optical and secondary-electron images. Auger Electron Spectroscopy (AES), and Auger mapping were essential in obtaining a comprehensive assessment and understanding of the surface reactions and kinetics. Oxygen was found to preferentially associate with hafnium. The

concentrations of HfO_2 decreased and that of Hf increased at elevated temperatures, indicating thermally activated tranpsort of HfO_2 into the bulk accompanied by Hf enrichment. The percent increase in surface enrichment, the activation energy, and the surface tension of pure hafnium were determined. A general theory regarding surface protection at elevated temperatures is proposed. 25 references, 17 figures, 4 tables.

24080 **(ORNL-tr—5204) Annealing of metastable orthorhombic phases of uranium-titanium alloys containing 4.8 and 9.5 at. % titanium.** Baschwitz, R.; Colombie, M.; Foure, M. (Oak Ridge National Lab., TN (USA); Compagnie pour l'Etude et la Realisation de Combustibles Atomiques (CERCA), 26 - Romans-sur-Isere (France)). 1968. Contract AC05-84OR21400. Translation source information not available . 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009978.

Ingots of U-Ti alloys were made in a resistance oven between 1350 and 1500°C, fused again, and then studied using micrography, hardness, and x-ray diffraction. Results indicate that the metastable phases of the U-Ti alloys behave differently from those of U-Mo and U-Nb. This difference may be linked to the atomic structure of the three metals, and certainly is linked to the existence of a U_2Ti compound. 14 figures. (DLC)

24081 **Sulfur and antimony segregation to creep cavity surfaces in Ni and an FCC Fe-Ni-Cr alloy.** White, C.L.; Schneibel, J.H.; Yoo, M.H. (Oak Ridge National Lab., TN). pp 347-358 of Proceedings of the second international conference on creep and fracture of engineering materials and structures. Swansea, England; Pineridge Press Ltd. ([1985]). Contract W-7405-ENG-26.

Small concentrations of low melting point metalloid impurities, such as S, Sb, Sn, and As, are often observed to reduce the creep ductility of otherwise ductile alloys at temperatures between 0.4 and 0.7 T/sub m/. The failure mode associated with this impurity effect usually involves formation, growth and interlinkage of cavities and microcracks on grain boundaries. Because the metalloid elements that cause this ductility loss are known to segregate to free surfaces and grain boundaries in a variety of alloy systems, it is generally accepted that the mechanism for enhanced cracking and cavitation at grain boundaries involves such segregation. The details of this mechanism are far from clear, however. Some of the interfacial properties that will be influenced by metalloid segregation are: (a) grain boundary and surface energies; (b) grain boundary and surface diffusivities; (c) grain boundary sliding; and (d) grain boundary migration.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 23391, 23525, 24101, 24228

24082 **(DOE/ER/01198—T8) Effect of hydrogen on the microstructure of silicon carbide.** Fischman, G.S. (Illinois Univ., Urbana (USA). Dept. of Ceramic Engineering). 1985. Contract AC02-76ER01198. 231p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85010229.

The effect of hydrogenation on the microstructure of a pressureless sintered silicon carbide was studied. Samples which were annealed in a 40:60 mole % H_2:Ar atmosphere at 1400°C for 50 hours were microstructurally compared with unannealed samples and samples that had been annealed in a similar manner but using an argon atmosphere. The results were also compared with microstructural results obtained from in situ studies using both hydrogen and argon atmospheres. These results were compared with a thermodynamic model which was constructed using a free energy minimization technique. The observed effects of hydrogenation were surface decarburization and amorphization throughout the silicon carbide material. Other observations include the thermally induced growth of microcrystalline silicon and accelerated amorphization around the silicon microcrystals in samples used in hydrogen in situ studies. An analysis of the microstructure of the reference material was also performed.

24083 **(DOE/ER/12044—2) Characterization and analysis of cavity development during creep of ceramics at elevated temperature. Progress report for 1983.** Page, R.A.; Lankford, J. Jr. (Southwest Research Inst., San Antonio, TX (USA)). 15 Oct 1983. Contract AS05-82ER12044. 101p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85010300.

The early stages of creep cavitation in sintered alumina are characterized using small angle neutron scattering (SANS). It is found that the initial cavity density is on the order of 10^{11} cm^{-3}, and that the average initial pore is approximately 60 nm in radius. The incubation time for nucleating additional pores during subsequent creep is extremely short, in agreement with theory based on the precipitation of grain-boundary diffusing vacancies. Pore density at constant stress and temperature is a linearly increasing function of time, again as predicted by classical nucleation theory. However, a local stress of 10^{-2} E is required to achieve the measured nucleation rate. Cavities are observed to lie primarily on two-grain junctions in linear arrays, with an average cavity radius of approximately 60 nm. It is hypothesized that the cavities nucleate at grain boundary ledges which provide the necessary local stress concentrations. Calculation of the individual cavity growth rate yields a zero or near zero value. This suggests a rapid transient growth period following nucleation which quickly decreases to a negligible growth rate.

24084 **(DOE/ER/13163—T2) Predicting microfracture in ceramics via a microcontact model.** (SKF Industries, Inc., King of Prussia, PA (USA)). [1984]. Contract AC02-84ER13163. 35p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85005654.

An index for brittle ceramic surfaces is proposed, namely, the proportion of contacts that result in cone cracking on the microscale. In developing this idea, use is made of data from the literature giving the static and sliding fracture loads of SiC and Mn-Zn-Ferrite ceramics under diamond indentor/sliders of varying radii. A fracture mechanics analysis developed by Frank and Lawn is used for the static case and one by Lawn is used for the sliding case, to convert the fracture load to the equivalent value that would result if the indentors were not diamond but were made of the ceramic itself. Topographical data gathered on two circumferentially ground ceramic disks (Si_3N_4 and ZrO_2) are then used illustratively with the Greenwood-Williamson microcontact model to calculate the 'fracture fraction' of contacts when each rough ceramic surface contacts a smooth surface of the same material, both statically and sliding with various values of the interfacial coefficient of friction. The paper includes general discussion of microcontact models with a summary of the Greenwood-Williamson model and a comparison of its predictions to those of the more general model ASPERSIM.

24085 **(DOE/ER/45126—1) Vibrational properties of disordered solids: far infrared studies.** Dutta, J.M. (North Carolina Central Univ., Durham (USA)). [1985]. Contract FG05-84ER45126. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010400.

Room-temperature dielectric properties at 245 GHz were measured for alumina and silicon nitrides of various grades, as also were the refraction index and absorption coefficient of quartz. Progress in other areas, such as computerized data acquisition and system enhancements, are summarized. (DLC)

24086 **(FEI—1427) Frequency spectrum of $V_{54}O_{11}$ disordered interstitial solid solution.** Danilkin, S.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700823.

The results of the frequency spectrum calculation of $V_{54}O_{11}$ disordered interstitial solid solution in concentration corresponding to the β-phase of the vanadium-oxygen system are presented in the paper. Solid solution disordering is taken into account by elementary cell increase up to 3ax3ax3a dimensions (a-lattice parameter) containing 54 vanadium atoms in lattice BCC points and 11 random distributed by octahedral positions of oxygen atoms. The vanadium-vanadium and oxygen-vanadium interaction is taken into account with accuracy up to second neighbours. In the $V_{54}O_{11}$ the bounda-

ry of vanadium atom oscillation frequencies is range shifted by 10 MeV into the high energies as compared with vanadium $G(\omega^2)$ frequency spectrum. At 42 meV in the $V_{14}O_{11}$ spectrum a peculiarity bound with oscillations of vanadium atoms surrounding oxygen is observed. Oxygen atom oscillations form bands localized near 61 and 79 MeV frequencies, band widths constitute 4 MeV, i.e. 30% of experimental widths in Vsub(0.83)Osub(6.17) [9] β-solid solution.

24087 (INIS-mf—9509) Simulation and interpretation of ESR powder spectra of some Gd^{3+} doped perovskites. Koopmans, H.J.A. (Technische Hogeschool Twente, Enschede (Netherlands)). 14 Oct 1983. 122p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85780827.

Includes Dutch summary.

The electron spin resonance technique is used to determine local symmetries of perovskites in powder form. Neutron diffraction techniques are used to investigate the overall structure of these compounds. Some model compounds have been doped with the paramagnetic Gd^{3+} ion which can be detected over a large temperature range and for which the substituted site in the lattice can be assigned without large difficulties. By means of some model compounds ($LaAlO_3$, $CaTiO_3$, $CaZrO_3$) the author tries to explain the observed esr powder spectra and to relate these spectra to the structure.

24088 Theory of ferromagnetic superconductors (invited). Whitehead, J.P.; Matsumoto, H.; Umezawa, H. (Department of Physics, Memorial University of Newfoundland, St. John's, Newfoundland AlB 3X7, Canada). *Journal of Applied Physics;* **57**: No. 8, 3093-3098(15 Apr 1985).

Since their discovery in 1977 the rare earth ternary superconductors have provided a number of unusual phenomena regarding the interplay of magnetism and superconductivity. In the case of the reentrant superconductors $ErRh_4B_4$ and $HoMo_6S_8$ the importance of the electromagnetic interaction, in determining the physical properties of these materials, was realized shortly after their discovery. More recent single crystal data indicate that in addition to the electromagnetic interaction the d—f interaction, although weak, gives rise to a number of dramatic properties notably the appearance of a first order transition at the upper critical field H/sub c/2. In this paper we outline a formalism which successfully incorporates both the electromagnetic interaction together with the d—f interaction in a mutually consistent manner. The results of our analysis based on this formalism are presented for the case of $ErRh_4B_4$ together with a comparison with the recent monocrystalline data.

24089 Anomalous surface impedance in reentrant ferromagnetic superconductors. Huang, C.Y.; Olsen, C.E.; Kozlowski, G.; Matsumoto, H.; Umezawa, H.; Mancini, F.; Maple, M.B.; Hamaker, H.C.; Torikachvili, M.S.; Whitehead, J.P. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **57**: No. 8, 3104-3106(15 Apr 1985).

We report evidence which suggests surface ferromagnetism in a ferromagnetic superconductor arising from the competition between the Meissner current shielding effect and the fluctuations of the localized magnetic moments. We have measured the surface impedance penetration depth Λ of $ErRh_4B_4$ and Er/sub 0.5/Ho/sub 0.5/Rh_4B_4 by employing a spectrometer operated at 9 GHz. For $ErRh_4B_4$, owing to the critical spin fluctuations just above T/sub s/ (> T/sub c/2), the critical temperature at which surface ferromagnetism appears, Λ^{-1} decreases smoothly as temperature decreases toward T/sub s/. For Er/sub 0.5/Ho/sub 0.5/Rh_4B_4, the decrease of Λ^{-1} arising from spin fluctuations for T > T/sub c/2 is very small, and Λ^{-1} decreases abruptly at T/sub c/2. We will discuss the theory and show how the predicted values of $\Lambda(T)$ compare well with the observed values.

24090 Small-angle neutron scattering of (Er/sub 0.8/Ho/sub 0.2/)Rh_4B_4. Pringle, O.A.; Mook, H.A.; Maple, M.B. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **57**: No. 8, 3110-3112(15 Apr 1985). Contract AT03-76ER70227.

The (Er/sub 1-x/Ho/sub x/)Rh_4B_4 pseudoternary alloy system has a minimum in the phase boundary between the superconducting and ferromagnetic phases near x = 0.3. This minimum has been identified as due to the competing magnetic anisotropies of Er and Ho. It has also been suggested that there could be a Lifshitz point near the minimum. Using the 30-m SANS camera at the National Center for Small-Angle Scattering Research at ORNL, we have observed a peak in the SANS pattern for (Er/sub 0.8/Ho/sub 0.2/)Rh_4B_4 at Q = 0.065 A^{-1}. This peak appears for temperatures between T/sub c/2, measured upon cooling, and T/sub m/, and corresponds to a modulation of the magnetic moment with a wavelength of about 100 A, demonstrating that the modulated moment phase exists away from the $ErRh_4B_4$ end of the phase diagram. The wavelength of the modulation is the same as was previously observed in $ErRh_4B_4$. The fact that the wavelength of the modulation remains finite near x = 0.3 appears to rule out the possibility of Lifshitz behavior near this point.

24091 Muon spin relaxation in $ErRh_4B_4$. Noakes, D.R.; Ansaldo, E.J.; Brewer, J.H.; Harshman, D.R.; Huang, C.Y.; Torikachvili, M.S.; Lambert, S.E.; Maple, M.B. (TRIUMF and Physics Department, University of British Columbia, Vancouver, Canada V6T 2A3). *Journal of Applied Physics;* **57**: No. 8, 3197-3199(15 Apr 1985). Contract AT03-76ER70227.

Data on zero-field μSR in $ErRh_4B_4$ are presented for temperatures from 4 to 300 K. Due to the large erbium moment, most of the muons have a relaxation time of less than 10 ns for temperatures below about 50 K. The data have been analyzed in terms of two distinct muon sites in the material. The deduced erbium relative fluctuation rate versus temperature is related to the crystalline electric field levels of erbium in the $RERh_4B_4$ structure.

24092 Ho-ion dynamics in Ho/sub x/Lu/sub 1-x/Rh_4B_4. Heffner, R.H.; Cooke, D.W.; Hutson, R.L.; Schillaci, M.E.; Smith, J.L.; Richards, P.M.; MacLaughlin, D.E.; Dodds, S.A.; Oostens, J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **57**: No. 8, 3107-3109(15 Apr 1985). Contract W-7405-ENG-36.

New μSR measurements of Ho-ion dynamics in Ho/sub x/Lu/sub 1-x/Rh_4B_4 are reported for x = 0.02 and 0.005. These compounds are superconducting below T/sub c/≅11 K. The measured concentration dependence of the Ho^{3+} spin-lattice relaxation rate Γ_0 is consistent with single-ion, conduction electron scattering (the Korringa mechanism) as the dominant process. Above about 10 K, Γ_0 is activated with an energy of 66 K, about 1/2 of the overall crystal-field splitting. Below about 10 K (in the superconducting state) a more gradual temperature dependence is observed, as reported previously for x = 0.70 and x = 0.02. This temperature dependence is not consistent with the usual exponential decay in the superconducting state. Using a model of conduction-electron-exchange scattering which includes the full crystal-field potentials, we show that a reasonably quantitative understanding of the overall temperature dependence can be achieved.

24093 Neutron scattering investigation of magnetic excitations at high energy transfers (invited). Loong, C. (Intense Pulsed Neutron Source Program, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **57**: No. 8, 3772-3777(15 Apr 1985).

With the advance of pulsed spallation neutron sources, neutron scattering investigation of elementary excitations in magnetic materials can now be extended to energies up to several hundreds of MeV. We have measured, using chopper spectrometers and time-of-flight techniques, the magnetic response functions of a series of d and f transition metals and compounds over a wide range of energy and momentum transfer. In PrO_2, UO_2, $BaPrO_3$, and CeB_6 we observed crystal-field transitions between the magnetic ground state and the excited levels in the energy range from 40 to 260 MeV. In materials exhibiting spin-fluctuation or mixed-valent character such as Ce/sub 0.74/Th/sub 0.26/, on the other hand, no sharp crystal-field lines but a broadened quasielastic magnetic peak was observed. The line width of the quasielastic component is thought to be connected to the spin-fluctuation energy of the 4f electrons. The significance of the neutron scattering results in relation to the ground state level structure of the magnetic ions and the spin dynamics of the f electrons is discussed. Recently, in a study of the spin-wave excitations in itinerant magnetic systems, we have extended the

spin-wave measurements in ferromagnetic iron up to about 160 MeV. Neutron scattering data at high energy transfers are of particular interest because they provide direct comparison with recent theories of itinerant magnetism.

24094 **Superconductivity and ferromagnetism in the orthorhombic system (Tbsub(x)Lusub(1-x)RuB_2).** Weidner, P. (Koeln Univ. (Germany, F.R.). 2. Physikalisches Inst.); Appl, S.L. (Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics); Shelton, R.N. (Geneva Univ. (Switzerland). Dept. de Physique de la Matiere Condensee). *Solid State Communications;* **53**: No. 2, 115-117(Jan 1985).

The pseudoternary orthorhombic system (Tbsub(x)Lusub(1-x)RuB_2) ($0 < = x < = 0.1$ and $x = 1.0$) has been investigated by static magnetization, ac susceptibility and resistivity measurements down to 1.5 K. Superconductivity occurs for $0 < = x < = 0.1$, while ferromagnetic order occurs for $x = 1.0$. For each sample studied, the Tb ion maintains a configurationally stable trivalent state. The initial linear depression of the superconducting transition temperature yields a coupling constant value $N(0)GAMMA^2$ between conduction electrons and magnetic Tb^{3+} moments of 3.5×10^{-4} ev-atom-states/spin-direction.

24095 **Effect of Fe^{2+} substitutional impurities on the stability of a $\Sigma = 5$ (100) CSL twist boundary in MgO: a theoretical study.** Wolf, D. (Argonne National Lab., IL). *Advances in Ceramics;* **6**: 36-43(1983). Contract W-31-109-ENG-38.

The binding energy of substitutional Fe^{2+} impurity in MgO to both the free (100) surface and to a $\Sigma = 5$ (100) CSL twist boundary has been calculated to be -0.92 and -1.05 eV, respectively. For most temperatures the impurity must therefore be considered as trapped once it has diffused to the planar defect. Interestingly, however, it is found that the Fe^{2+} impurity has to approach either the surface or the interface as closely as one lattice plane before being affected by the presence of the planar defect. The results for the free surface are in very good agreement with recent calculations of Colbourn and Mackrodt. 16 references, 4 figures.

24096 **Auger electron spectroscopy analyses of fracture surfaces in TiB_2 ceramics.** Tennery, V.J.; White, C.L.; Padgett, R.A.; Finch, C.B. (Oak Ridge National Lab., TN). *Advances in Ceramics;* **6**: 312-324(1983). Contract W-7405-ENG-26.

The compositions on grain-boundary and transgranular fracture surfaces of TiB_2 ceramics were analyzed by using Auger electron spectroscopy (AES). The ceramics were densified by hot-pressing with and without use of Ni additives. Bulk chemical analyses indicated that the TiB_2 powders used in fabricating these ceramics contained up to 3 wt% O, about 600 ppm (wt) of Fe, and up to about 800 ppm (wt) of S, as well as Al, Ca, Cr, Cu, Si, W, and Zr at levels of 100 ppm (wt) or greater. When no Ni additive was employed, the AES results indicated that Fe, S, and O were concentrated at the TiB_2 grain boundaries. In addition, the Fe, S, and O were not strongly associated with each other, and their local concentrations varied substantially from facet to facet on the same grain. The transgranular TiB_2 fracture surfaces contained only Ti and B, indicating that the impurity elements were distributed in the TiB_2 such that they were below the detection limit of the spectrometer. The oxygen-bearing phase contained Ti and B. Ion sputtering to remove 50-70 atom layers resulted in removal of the S- and Fe-containing material from TiB_2 grain facets. Use of the Ni sintering aid in the ceramics resulted in the absence of Fe from the grain boundaries and in a substantial reduction of the S and O concentrations. AES analysis of metallographic sections after sputtering confirmed the existence of a phase containing a high concentration of Ti and O. 6 references, 7 figures, 2 tables.

24097 **Hydrogen mobility in crystalline and amorphous Zr_3PdH/sub x/.** Bowman, R.C. Jr.; Attalla, A.; Maeland, A.J.; Johnson, W.L. (Monsanto Research Corp.-Mound, Miamisburg, OH). *Solid State Communications;* **47**: No. 10, 779-782(1983). Contract AM03-76SF00767;AC04-76DP00053.

NMR measurements of proton rotating-frame relaxation times were made to deduce hydrogen diffusion parameters for crystalline and amorphous Zr_3PdH/sub x/. Enhanced proton mobility was observed in glassy a-Zr_3PdH/sub 2.9/ relative to diffusion behavior in any crystalline Zr_3PdH/sub x/ sample. Both host crystal structure and proton site occupancy make significant contributions to the diffusion process where smaller activation energies correspond to jumps involving octahedral sites. 14 references, 3 figures, 1 table.

24098 **Metallography of niobium/alumina interfaces.** Kelly, M.D.; Abernathy, M.K. (Mound Facility, Miamisburg, OH). *Microstructural Science;* **11**: 313-317(1983). Contract AC04-76DP00053.

Niobium pins were investigated as potential electrical feedthroughs in alumina ceramic components. The pins were diffusion bound to the alumina substrates during sintering to form the feedthroughs. The resulting parts required metallography to evaluate the interfacial reactions. Metallographic techniques to properly prepare the niobium surface for analysis while maintaining the ceramic interface required etch/polish techniques to remove the disturbed metal. The interfacial reactions observed show silicon-niobium diffusion which results in a strong pin-ceramic bond.

3603 Composite Materials

REFER ALSO TO CITATION(S) 23997, 24110

24099 **(RFP—3733) Literature survey of discontinuous-fiber-reinforced composites with emphasis on pressure vessels.** Bagaasen, L.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 16 Mar 1985. Contract AC04-76DP03533. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010386.

The critical fiber length (l/sub c/) plays a major role in determining the strength, stiffness (elastic modulus), and toughness (fracture energy) of discontinuous-fiber-reinforced composites. Composite toughness is maximized when the fiber length (l) is approximately equal to l/sub c/, while the strength and stiffness increase rapidly as l goes from $l < l/sub c/$ to $l = l/sub c/$ and continue to increase as l increases to 10 l/sub c/. At 10 l/sub c/, discontinuous-fiber-reinforced composites behave similarly to continuous-fiber-reinforced composites. Randomly oriented, discontiuous composites can be formed using techniques such as injection molding or hot press molding. The volume fraction of fibers which these mehtods can tolerate is about 25%, but the ability to use stronger, single crystal, discontinuous fibers (whiskers) would help offset any loss in composite strength. Calculations demonstrate that the tensile strength of the biaxially isotropic composite in any direction (in the random plane) can ideally be comparable to the unidirectional strength of a continuous-fiber-reinforced composite. Randomly oriented discontinuous-fiber-reinforced composites would offer several advantages over continuous-fiber-reinforced composites such as easier fabrication techniques and simplified stress analysis.

24100 **(SAND—84-2375C) Slow crack growth in metal reinforced glass composites.** Mecholsky, J.J.; Jessen, T.L.; Moore, R.H. (Pennsylvania State Univ., University Park (USA); Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 10p. (CONF-850122—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010094.

From 9. annual conference on composites and advanced ceramic materials and workshop on testing methods for ceramic matrix composites; Cocoa Beach, FL, USA (20 Jan 1985).

We measured crack velocity as a function of stress intensity using the applied moment double cantilever beam technique for Kovar metal sphere reinforced borosilicate glass matrix composites. The slow crack growth measured in the metal reinforced glass composites demonstrated that the reinforcement impedes the crack front so that higher stress intensity is required for higher volume fraction reinforcement to achieve the same crack velocity. The stress corrosion susceptibility, n, was approximately the same for the glass and for the composites. Fractographic evidence showed crack fron interaction with the Kovar particles. The difference in behavior with small and large cracks is discussed.

24101 Metallography of consolidated thermites. Kelly, M.D.; Cramer, J.J. (Mound Facility, Miamisburg, OH). *Microstructural Science;* **11**: 343-348(1983). Contract AC04-76DP00053.

A process to press aluminum-copper oxide and aluminum-iron oxide thermites into strong, high-density composites for use as chemical heat sources has been developed. Metallography of the consolidated thermites and their reaction products required careful preparation in sectioning, grinding, and polishing because of the extreme differences in hardness between the metal matrix and the oxides. Using metallography as an analytical tool, consolidated thermites of uniform density and composition have been evaluated. 6 figures.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 23831, 24593

24102 (DOE/ER/10275—1C, pp 1, Paper 58) **Effect of gamma irradiation on the mechanical properties and stress relaxation behavior of polyimides.** Ross, C.D. (Virginia Univ., Charlottesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

This paper examines the effects of gamma irradiation on the mechanical properties and stress relaxation behavior of polyimides. Polyimides, a group of polymers exhibiting extremely high thermal stability, are widely used in printed circuit boards. Residual stresses can often build up between the polyimide itself and the polymer substrate, leading to failure. It has been proposed that gamma irradiation of polyimides can induce stress relaxation, alleviating this mode of failure. The effect of this radiation on the attractive mechanical properties of polyimides will also be discussed.

24103 Distribution functions for polyoxide chains, including poly(oxymethylene) helices containing known numbers of disruptions. Curro, J.G.; Mark, J.E. (Physical Properties of Polymers Division, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **82**: No. 8, 3820-3823(15 Apr 1985). Contract AC04-76DP00789.

Monte Carlo simulations based on rotational isomeric state models were used to generate distribution functions for the end-to-end separation of polyoxide chains having the repeat unit [—(CH_2)/ sub m/O—]. High temperatures minimize differences in the distributions arising from differences in conformational preferences, nonetheless even at 200 °C poly(oxymethylene) (m = 1) has a narrower distribution than poly(oxyethylene) (m = 2), poly(trimethylene oxide) (m = 3), and polyethylene (m→∞), presumably because of its helicity. Decrease in temperature or increase in chain length bring out important differences in the distributions, including the appearance or disappearance of multiple maxima in the case of the helical poly(oxymethylene). The multimodal distributions are elucidated by construction of separate distributions for chains with specified numbers of helical disruptions.

24104 Thermally stimulated current studies of X-ray induced photocarriers in poly(ethylene terephthalate) dielectrics. Kurtz, S.R.; Arnold, C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-31**: No. 6, 1284-1288(Dec 1984).

A thermally stimulated current technique is used to depopulate shallow electronic charge carrier traps in poly(ethylene terephthalate) films. In undoped films, a broad energy distribution of traps are populated following irradiation. By introducing a chemical dopant that acts as a deep photocarrier trap, the shallow trap population and subsequent transport of photocarriers is radically reduced. Based on results for films containing known dopant concentrations, the authors estimate the density and trapping parameters of the intrinsic trap states.

3606 Other Materials

REFER ALSO TO CITATION(S) 23405, 23575, 23576, 23577, 23579, 23618, 23620, 23794, 23822, 24044, 24062, 24088, 24829

24105 (IC—84/97) Soliton and polaron generation in polyacetylene. Su, Zhao-bin; Yu, Lu. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700509.

The nonradiative decay of an e-h pair into soliton pair and that of an electron (hole) into polaron as well as the photoproduction of soliton pairs are considered using the lattice relaxation theory of multiphonon processes generalized to include the self-consistency of the multi-electron states with the lattice symmetry breaking. The selection rule which forbids the direct process of photogeneration for neutral pair is derived from the symmetry arguments. The branching ratio of the photogenerated neutral to charged soliton pairs is estimated. The recent related experiments are discussed.

24106 (IFUSP-P—429) Optical absorption and electron spin resonance in natural, irradiated and heated spodumene. Ito, A.S.; Isotani, S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1983. 46p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700504.

Heat treatment and X and γ-Rays irradiation of lylac and colorless natural spodumene, $LiAlSi_2O_6$, have been studied. Irradiation produces a color change, from lylac or colorless to green. Irradiated samples heated at 200°C turn lylac and bleach at 400°C. Optical absorption spectra were decomposed into gaussian line shape bands and it is observed that green and lylac centers are simultaneously created by irradiation. These centers are independent from each other. Optical absorption, EPR and X-Ray fluorescence results show the spectra of impurities, responsible by the presence of the created centers and indicated Mn participation in the process of centers creation and destruction. Decay kinetics of green and lylac centers have been studied and it is observed that simple kinetic models do not apply to these cases. An empirical fit allowed the calculation of activation energies of the lylac and green centers decays. Discussions about the present results led us to propose a new model where the green and lylac centers are due to Mn^{3+} ions in two different Al^{3+} sites, whose absorption are intensified by the interaction with an electron trapped in a neighbour oxygen.

24107 (IFUSP-P—436) Optical absorption in irradiated natural beryl. Isotani, S.; Dias, O.L.; Albuquerque, A.R.P.L. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700505.

Three species of beryl irradiated with γ-rays of ^{60}Co were studied by optical absorption. One became yellow and the other two Maxixe's blue. The effects of heat treatments were determined by the thermal isochronal decays of the optical absorption bands. Activation energies and frequency factor were obtained through the first order process kinetic model. Discussions lend us to assign for the UV band-edge the model of absorption by a hole center stabilized by a Fe^{3+} (substituting Al^{3+}) ion in a neighbour oxygen.

24108 (IFUSP-P—437) Comparative study of five varieties of spodumene through optical absorption. Fujii, A.T.; Isotani, S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Nov 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700506.

A comparative study of five varieties of spodumene crystals from Brazil through optical absorption spectroscopy, classified according to the colours lylac, colourless I, colourless II, yellow and green is reported. This series shows a consistent increase of the [Fe]/[Mn] ratio. The principal bands in the yellow sample are at 7,000 and 9,000 cm^{-1}, and in the green sample besides these bands a band at 16,000 cm^{-1} is observed. In lylac, colourless I and colourless II samples, the principal bands are at 18,000 cm^{-1} and when irradiated two new bands appears at 15,700 cm^{-1} (E perpendicular to c) and 11,000 cm^{-1} (K perpendicular to c). It is suggested that in green and yellow samples the bands are due to Fe^{2+} (at 7,000 cm^{-1}

and 9,000 cm^{-1}) and due to Fe^{3+} - Fe^{3+} charge transfer (at 16,000 cm^{-1}). In lylac and colourless I samples the model for Mn^{3+} at two different sites is applied. The colourless II corresponds to the case in which Mn^{3+} is at one site alone, being prohibited from occupying the second site due to higher Fe concentration.

24109 **(IFUSP-P—449) Lower temperature phase of a nematic lyomesophase system.** Amaral, L.Q. do. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700508.

The system Na decyl sulphate/water/decanol/Na sulfate, which forms a nematic N sub(L) lyomesophase with planar micelles at 25°C, changes to a G phase at 22°C on cooling. Phase G studied by x-ray diffraction has a lamellar structure with repetition distance 31.4 A. Comparison of observed and calculated intensities from a step function model defines the G phase as a coagel where lamellae aggregates of extended tilted bilayers with only one layer of solvation water between lamellae, are dispersed in water. This result gives support to the model of aggregates of micelles in the N sub(L) phase, previously proposed.

24110 **(JAERI-M—83-178) Strontium diffusion in polycrystalline graphite and graphite/carbon matrices.** Kikuchi, Teruo; Ikawa, Katsuichi; Ishimoto, Kiyoshi. (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 19p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700888.

Diffusion coefficients of strontium in parallel and perpendicular directions to pressing of three types of reactor grade graphite and two types of graphite/carbon matrix have been determined in the temperature range 1200 - 1350 °C. The diffusion rates of strontium in the parallel direction to the pressing of anisotropic needle coke graphite were slightly higher than those observed in the perpendicular direction, but little difference was found in the diffusion rates on the pressing direction of fine grained petroleum coke graphite and graphite/carbon matrices. The activation energies of strontium diffusion in graphite/carbon matrices were found to be larger than those of polycrystalline graphite.

24111 **(JINR—14-84-69) Domain packing and temperature dependence of the spontaneous shear angle in ferroelastic compound $KD_3(SeO_3)_2$.** Balagurov, A.M.; Beskrovnyj, A.I.; Savenko, B.N.; Datt, I.D.; Shuvalov, L.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700824.

The domain structure in the ferroelastic phase of $KD_3(SeO_3)_2$(DKTS) compound was investigated by neutron time-of-flight diffractometry. The temperature dependence of spontaneous shear angle was determined from diffraction intensity measurements for a lot of spots in reciprocal lattice. The domain structure was found similar with that of KH_2PO_4.

24112 **(LBL—17530) Polarization dependent Ge and Si(111) 2 x 1 surface state optical absorption: a test of surface reconstruction models.** Olmstead, M.A.; Amer, N.M. (Lawrence Berkeley Lab., CA (USA)). Aug 1984. Contract AC03-76SF00098. 9p. (CONF-840879—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009939.

From 17. international conference on the physics of semiconductors; San Francisco, CA, USA (6 Aug 1984).

We have studied the (111) 2 x 1 surface state absorption of both Si and Ge using polarization-dependent photothermal displacement spectroscopy. In addition to investigating the room temperature cleaved surface, we have also monitored the temperature dependence of the surface absorption as it is changed during annealing of the Ge(111) surface from the 2 x 1 to the c-2 x 8 structure.

24113 **(N—85-13009) Alpha-form of the hydroxides of bivalent metals.** Feitknecht, W. (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1984. 27p. (NASA-TN—77508). NTIS, PC A03/MF A01.

X-ray analyses were made of the hydroxides of the bivalent metals. The freshly pptd. hydroxide is usually in the alpha-form, which on standing is converted to another form or other forms. The alpha and c grating dimensions of the alpha-form and the C6-type of Co, Zn, C, Co-Zn and Ni-Zn hydroxides are tabulated. Ni hydroxide does not exhibit an alpha-form. The alpha-Co(OH)2, the blue form, is stabilized by sugar or by the higher alcohols: these compounds do not stabilize alpha-Zn(OH)2.

24114 **(NP—4901631) Yearly inspection of concrete test specimens at Treat Island containing fly ash, silica fumes and slag for the Department of Energy, Mines and Resources.** Bremner, T.W. (New Brunswick Univ., Fredericton (Canada)). Dec 1983. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE84901631.

In view of the limited number of years that the concrete test specimens have been at the exposure site it would appear prudent to wait a little longer before making specific recommendations. The variables investigated are such that deterioration is on the threshold of proceeding rapidly and to obtain maximum information the specimens should be examined and studied closely over the next decade. During that time the effect of mix proportion, cement type and the role of supplementary cementing materials should become evident. It is of prime importance to maintain adequate labeling and documentation of the specimens at the site so that should a storm disrupt the installation the specimens can be identified and repositioned. 1 figures, 4 tables.

24115 **(NUREG/CR—4198) Fracture in glass/high level waste canisters. Final report.** Martin, D.M. (comp.). (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Apr 1985. 79p. NTIS, PC A05/MF A01 - GPO $4.50. File Number TI85901319.

The release rate of radionuclides from a vitrified waste form due to aqueous leaching by ground water will depend, among other factors, on the waste form's surface area. Large castings of glass will almost certainly be used as the waste form for high-level nuclear wastes and such castings tend to fracture as a result of transient and residual stresses induced by the casting process; such fractures increase the surface area available for aqueous leaching of radionuclides from the HLW glass. The primary focus of this study was on achieving an understanding of the dependence of fracture surface area on glass properties and processing variables for both in-can melts and castings. The maximum fracture surface area per unit volume of glass observed in this study was about 7.1/cm (an equivalent spherical particle diameter of 0.85 cm) for a water quenched in-can melt. Two important results of this work are as follows: The presence of a small fraction of bubbles in the glass can relieve intense hydrostatic tension stresses which could lead to large fracture surface areas. From the thermally induced fracture standpoint, a mechanically weak waste form may be beneficial, since this will result in fracture early in the cooling process, thereby avoiding the buildup of large stresses. In addition, the fracture surface energy or fracture toughness of the waste form should be large to minimize the surface area created by fracture processes. 15 references, 42 figures, 5 tables.

24116 **(OSU—81-00070) Laboratory report on preparation of specimens for durability of Portland cement/fly ash concrete: Phase IV, for the Department of Energy, Mines and Resources.** Bremner, T.W. (New Bruswick Univ., Fredericton (Canada). Dept. of Civil Engineering). 30 Nov 1981. 21p. NTIS (US Sales Only), PC A02/MF A01. File Number DE84901591.

Contracts were awarded to prepare large concrete specimens that are to be used in durability studies at the US Corps of Engineers' salt water exposure site at Treat Island, Maine. This report covers the use of Type 10 and Type 50 cement in concrete made from sand and limestone coarse aggregate. The contract covered three water-cement ratios, two types of Portland cements and with and without the replacement of cement by fly ash. (DLC)

24117 **(PUC-TN—10/82) Optical absorption of triplet molecular excitons in alkali cyanides.** Camargo Junior, S.S.; Weid, J.P. von der. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jul 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700489.

The optical absorption spectra of alkali cyanides in the UV region present a set of weak absorption bands which are identified

as triplet $a'^3\Sigma^+$ molecular excitons. The nature of the molecular exciton transitions in the ionic-molecular crystals is discussed and the existence of an admixture between molecular exciton and charge transfer exciton states is suggested.

24118 **(PUC-TN—12/82) Coupling between molecular and charge transfer excitations in mixed alkali halide-cyanide crystals.** Camargo Junior, S.S.; Weid, J.P. von der. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Aug 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700490.

The optical absorption spectra of mixed alkali halide cyanide crystals (M(CN) sub(x) Y sub(1-x) where M = Na, K, Rb and Y = F, Cl, Br, I) were measured at temperatures ranging from 300K down to 4.2K and CN^- concentrations from 10^{-2}% up to pure cyanide crystals. The absorption cross sections of the parity forbidden X sup(1)$\Sigma^+ \rightarrow a'^3\Sigma^+$ vibronic transition of the CN^- molecular ions were found to present a strong, non linear dependence on the x-composition of the mixed crystal as well as on the halide ion. This behaviour is explained by the coupling of the triplet molecular excitations to singlet charge transfer excitations in their neighbourhood. The experimental data were fit with a coupling energy of a few meV, depending mainly on the type of excitations involved (localized or collective) and not on the particular halide ion. The coupling mechanism is discussed and it is found to be due to the overlap between the wave functions of the two excitations.

24119 **(SAND—84-2308C) Oxygen-nitrogen interactions in ion-implanted silicon.** Stein, H.J. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 5p. (CONF-850421—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010091.

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

Interaction of oxygen and nitrogen in ion-implanted crystalline silicon layers has been investigated by infrared absorption. Infrared absorption bands which are not produced by either ^{14}N or ^{16}O alone are observed after sequential implantation of ^{14}N and ^{16}O into overlapping profiles followed by annealing at 500°C. The new bands indicate oxygen-nitrogen interactions and are ascribed to Si-N vibrational modes with oxygen in nearby interstitial sites.

24120 **(SAND—84-2365C) Thermal donor removal by rapid thermal annealing: infrared absorption.** Stein, H.J.; Kahn, S.K.; Shatas, S.C. (Sandia National Labs., Albuquerque, NM (USA); Siltec Corp., Mountain View, CA (USA); AG Associates, Palo Alto, CA (USA)). 1985. Contract AC04-76DP00789. 6p. (CONF-850421—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010092.

From 2. spring meeting of the Materials Research Society; San Francisco, CA, USA (15 Apr 1985).

Rapid thermal annealing of thermal donors in Si with 10 anneal times at temperatures between 600 and 1000°C has been investigated by infrared absorption at 80°K. Thermal donors A through D, which are identified by excited state absorption, are present in as-grown Czochralski Si; whereas excited states for donors A through F as well as photoionization of thermal donors are observed after extended heating at 450°C. The temperature required for rapid thermal annealing is lower when only donors A through D are present. Removal of thermal donors A through F by rapid thermal annealing at temperatures $\geq$ 800°C restores 7 to 8 oxygen atoms to interstitial sites per electrically measured donor removed. This ratio supports oxygen cluster models for thermal donors but does not support previous suggestions that such clusters are embryonic forms of high temperature oxygen precipitates.

24121 **(SERI/TR—211-2480) Anisotropic electron-impurity scattering in dilute AlLi: (small) corrections to the local density approximation.** Cole, L.A.; Lawrence, W.E. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1985. Contract AC02-83CH10093. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85002946.

This report examines several improvements to a previously reported calculation of Dingle temperatures for dilute AlLi, including self-interaction corrections and other nonlocal effects in the exchange and correlation potential. The scattering rates or Dingle temperatures are changed only slightly from the values obtained previously using the Kohn-Sham density-functional method with the local density approximation. In particular, the calculated anisotropy remains strong, and the discrepancy with observed isotropy is unresolved.

24122 **Observation of electron transport in polyethylene terephthalate and the radiation hardening of dielectrics.** Kurtz, S.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **46**: No. 11, 1105-1107(1 Jun 1985).

Electron-induced conductivity measurements were performed on polyethylene terephthalate to compare electron and hole contributions to the radiation-induced conductivity. The electron mobility in this material was found to be $>$ or $\approx 10^2$ times that of the holes. This result explains an earlier observation that the radiation-induced conductivity of polyethylene terephthalate can be radically reduced by chemically doping this dielectric with electron acceptor molecules.

24123 **Dependence of critical layer thickness on strain for In/sub x/Ga/sub 1-x/As/GaAs strained-layer superlattices.** Fritz, I.J.; Picraux, S.T.; Dawson, L.R.; Drummond, T.J.; Laidig, W.D.; Anderson, N.G. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **46**: No. 10, 967-969(15 May 1985).

Various In/sub x/Ga/sub 1-x/As/GaAs strained-layer superlattices have been characterized by Hall effect, ion beam channeling, and photoluminescence measurements in order to evaluate their crystalline quality. Structural characteristics (e.g., layer strains and thicknesses) were obtained from channeling or x-ray diffraction studies. The structures had strains in the alloy layers of 0.5—2.7%. Critical layer thicknesses for degradation of sample quality are in good agreement with the theoretical expression proposed by J.W. Matthews and A.E. Blakeslee [J. Cryst. Growth 27, 118 (1974)]. Our results provide important information for design of strained-layer devices.

24124 **Models for electron mobility and temperature of two-dimensional electron gas at low and moderate fields.** Lee, H.P.; Vakhshoori, D.; Lo, Y.H.; Wang, S. (Department of Electrical Engineering and Computer Sciences, and the Electronics Research Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **57**: No. 10, 4814-4816(15 May 1985).

A theoretical model of electron temperature and electron mobility as a function of electric field has been formulated for GaAs/Al/sub x/Ga/sub 1-x/As heterostructures. The predicted results from this model agree well with available measurements at low and moderate fields (E > 200 V/cm). Furthermore, this model enables us to predict the electron temperature and mobility at high fields which are crucial to the understanding of the potential performance of GaAs/Al/sub x/Ga/sub 1-x/As modulation-doped field effect transistor and other novel heterostructures.

24125 **Resonance Raman scattering of the excited triplet ($^3B^+$/sub 2u/) electronic state of naphthalene in fluid media.** Fisher, M.R.; Tripathi, G.N.R. (Radiation Laboratory, University of Notre Dame, Notre Dame, Indiana 46556). *Journal of Chemical Physics;* **82**: No. 10, 4721-4723(15 May 1985).

Resonance Raman spectra of the photoexcited lowest triplet ($^3B^+$/sub 2u/) state of naphthalene (N-h_8 and N-d_8), observed in solution by time-resolved technique, are reported. Eight Raman bands (396, 496, 741, 958, 1337, 1395, 1440, and 2676 cm^{-1}) have been observed in N-h_8 and ten (479, 690, 754, 1005, 1142, 1281, 1356, 2491, 2638, and 2714 cm^{-1}) in N-d_8. Vibrational assignments are briefly discussed.

24126 **Magnetism and superconductivity in Eu(Ho)Mo_6S_8.** Capone, D.W. II; Lai Fook, M.S.; Guertin, R.P.; Hinks, D.G.; Dunlap, B.D.; Foner, S.; Abou-Aly, A.I.; Brooks, J.S. (Tufts University, Medford, Massachusetts 02155). *Journal of Applied Physics;* **57**: No. 8, 3070-3072(15 Apr 1985).

A variety of ambient and high-pressure experimental results reveal the interplay between magnetism and superconductivity in Ho-doped samples of the pressure-induced superconductor, $EuMo_6S_8$. Ho concentrations up to 50 at. % of the rare-earth ions were used. High-resolution magnetic measurements are consistent with the crystalline electric field ground state for the Ho^{3+} ions being a magnetic doublet consisting largely of J/sub z/ = +- 8. The results of high-pressure magnetization experiments reveal negligible effects of reduced lattice constant on the rare earth-rare earth interactions. Resistivity in a 10 at. % sample for P = 10 kbar shows the suppression of a P = 0 structural transition, metallic conductivity down to low temperatures, and finally superconductivity at 8 K. The upper critical field, H/sub c/2(T), for this sample was measured for P = 7, 10, and 12 kbar and showed strong reentrant behavior [dH/sub c/2(T)/dT > 0 as T→0 K]. A minimum with field in the resistivity above H/sub c/2 was also observed at lowest temperatures. The H/sub c/2(T) data are compared with those of $EuMo_6S_8$ at high pressure, which show positive curvature, and $HoMo_6S_8$, in which superconductivity is quenched by ferromagnetism at low temperatures.

24127 **Upper critical fields in $RE_2Fe_3Si_5$ (RE = Y, Sc, Lu) compounds.** Umarji, A.M.; Malik, S.K.; Shenoy, G.K. (Materials Science and Technology Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **57**: No. 8, 3118-3120(15 Apr 1985).

The $RE_2Fe_3Si_5$ compounds form with RE = Sm, Gd to Lu, Sc and Y and crystallize in the tetragonal $Sc_2Fe_3Si_5$-type structure. The compounds with RE = Lu, Y, and Sc are superconducting while those with RE = Gd to Er are antiferromagnetically ordered. We have carried out upper critical field (H/sub c/2) measurements on $Y_2Fe_3Si_5$, $Sc_2Fe_3Si_5$ and $Lu_2Fe_3Si_5$. The Lu compound, with the zero field T/sub c/ of 6.0 K, has H/sub c/2(0) = 60 kOe, which is the highest for an iron-containing ternary compound. The results of critical field measurements have been analyzed in terms of WHH theory.

24128 **Peltier heat of a small polaron in a magnetic semiconductor.** Liu, N.H.; Emin, D. (Department of Physics, University of California at Riverside, Riverside, California 92521). *Journal of Applied Physics;* **57**: No. 8, 3213-3215(15 Apr 1985). Contract AC04-76DP00789.

For the first time the heat transported with a small polaron in both antiferromagnetic and ferromagnetic semiconductors is calculated. This heat, the Peltier heat, π, is obtained from the change of the entropy of the total system upon introduction of a charge carrier. We explicitly consider both the intrasite and intersite exchange interactions between a small polaron and the interacting spins of a spin-1/2 magnet. There are two competing magnetic contributions to the Peltier heat. First, adding the carrier increases the spin entropy of the system. This provides a positive contribution to π. Second, the exchange between the carrier and the sites about it enhances the exchange binding between these sites. This reduces the energetically allowable spin configurations and provides a negative contribution to π. At extremely high temperatures when kT exceeds the intrasite exchange energy, the first effect dominates. Then π is simply augmented by kT ln 2. However, well below the magnetic transition temperature the second effect dominates. In the experimentally accessible range between these limits both effects are comparable and sizable. The net magnetic contribution to the Peltier heat rises with temperature. Thus, a carrier's interactions with its magnetic environment produces a significant and distinctive contribution to its Peltier heat.

24129 **Neutron-spin-echo study of the reentrant spin glass Eu/sub x/Sr/sub 1-x/S.** Shapiro, S.M.; Maletta, H.; Mezei, F. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* **57**: No. 8, 3485-3487(15 Apr 1985). Contract AC02-76CH00016.

Neutron-spin-echo (NSE) experiments were performed on polycrystalline samples of Eu/sub x/Sr/sub 1-x/S for x = 0.4 and 0.54 in the temperature range of 1.2 < T < 10 K and for 0.036 < Q < 0.18 A^{-1}. The x = 0.4 sample exhibits a paramagnetic (PM) to spin-glass (SG) transition near T/sub g/ ~2 K. In the x = 0.54 sample, large ferromagnetic correlations develop below 5 K and a SG state appears at lower temperatures. In the NSE experiment, the spin-spin correlation function S(Q,t) is measured directly for times between 0.03 < t < 5 nsec. At low temperatures, both materials exhibit a weak Q dependence in the dynamics and the spins are essentially frozen over the time range explored. On heating the x = 0.4 sample, the spins start to fluctuate more rapidly, but no dramatic change occurs around T/sub g/. On heating the x = 0.54 sample, S(Q,t) = decreases rapidly with time. Near 5 K, S(Q,t) is exponential (e/sup -Gammat/) with Γ being strongly Q dependent. Measurements of the depolarization of the scattered beam confirms the absence of true long-range ferromagnetic order below T/sub c/ .

24130 **UFe_4P_{12} and $CeFe_4P_{12}$: Nonmetallic isotypes of superconducting $LaFe_4P_{12}$.** Meisner, G.P.; Torikachvili, M.S.; Yang, K.N.; Maple, M.B.; Guertin, R.P. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **57**: No. 8, 3073-3075(15 Apr 1985). Contract AT03-76ER70227.

The new compound UFe_4P_{12}, which was found to be isostructural to superconducting $LaFe_4P_{12}$ and have a lattice constant of 7.7729 A, is a semiconductor and shows ferromagnetic order below 3.15 K. $CeFe_4P_{12}$ is also a semiconductor, and its magnetic susceptibility is unusually small in comparison to $LaFe_4P_{12}$. The semiconducting behaviors of both UFe_4P_{12} and $CeFe_4P_{12}$ seem anomalous and may arise from strong f-electron hybridization.

24131 **Measurement of the induced moment magnetic form factor of a heavy fermion superconductor.** Stassis, C.; Axe, J.D.; Majkrzak, C.F.; Batlogg, B.; Remeika, J. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Applied Physics;* **57**: No. 8, 3087-3089(15 Apr 1985). Contract AC02-76CH00016;W-7405-ENG-82.

Polarized neutron scattering techniques have been used to study the spatial distribution and temperature dependence of the magnetization induced in a single crystal sample of $CeCu_6Si_6$ by a magnetic field of 50 kOe. We find that at 4.2 K (> T/sub c/), the induced magnetization is predominantly of 4f electronic character. No evidence was found of any change in the magnetic form factor between 300 and 4.2 K.

24132 **Hysteresis, metastability, and time dependence in d = 2 and d = 3 random-field Ising systems.** Belanger, D.P.; Rezende, S.M.; King, A.R.; Jaccarino, V. (Physics Department, University of California, Santa Cruz, California 95064 and Brookhaven National Laboratory, New York 11973). *Journal of Applied Physics;* **57**: No. 8, 3294-3296(15 Apr 1985).

The hysteretic properties of random-field Ising model (RFIM) systems were studied. Using neutron scattering, a relatively narrow metastability boundary T/sub F/(H) in the d = 2 (d = d/sub I/) RFIM system Rb_2Co/sub 0.85/Mg/sub 0.15/F_4 was found to lie well below the rounded specific heat peak "T/sub c/(H)" of the (destroyed) phase transition. T/sub F/(H) scales as T/sub N/-T/sub F/(H)proportionalH/sup 2/phi/ with the RF crossover exponent phi = 1.74 +- 0.02. At T/sub F/(H), equilibrium is approached logarithmically with time. In the d = 3 (d>d/sub I/) RFIM system Fe/sub 0.6/Zn/sub 0.4/F_2 AF order was found to be stable against changes of T and H below the observed sharp phase transition boundary T/sub c/(H), while the field-cooled domain state was not. Capacitance measurements in Fe/sub 0.68/Zn/sub 0.32/F_2 established that equilibrium prevails for T > or = T/sub eq/(H) which is slightly above T/sub c/(H). Pronounced logarithmic time dependence is observed at T < or ≈T/sub c/(H).

24133 **1S core-level spectroscopy of graphite: The effects of phonons on emission and absorption and validity of the final-state rule.** Franck, C.P.; Schnatterly, S.E.; Zutavern, F.J.; Aton, T.; Cafolla, T.; Carson, R.D. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). *Physical Review* [*Section*] *B: Condensed Matter;* **31**: No. 8, 5366-5370(15 Apr 1985).

We have used both electron-induced soft x-ray emission and fast inelastic electron scattering to observe 1S core-level emission and absorption in graphite near threshold. Linear phonon coupling

with partial relaxation is found to quantitatively explain the absorption linewidth, the emission broadening, and the unusually large difference between emission and absorption threshold energies (Stokes shift). Both emission and absorption line shapes quantitatively obey the final-state rule, which asserts that the best single-particle potential describing these many electron processes is the final-state potential.

24134 **Phase diagram of selenium adsorbed on the Ni(100) surface: A physical realization of the Ashkin-Teller model.** Bak, P.; Kleban, P.; Unertl, W.N.; Ochab, J.; Akinci, G.; Bartelt, N.C.; Einstein, T.L. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **54**: No. 14, 1539-1542(8 Apr 1985). Contract AS05-79ER10427;AC02-76CH00016.

We have used electron diffraction to study submonolayers of Se adsorbed on Ni(100); p(2 x 2), c(2 x 2), and disordered phases were observed and the boundaries between them located. Symmetry arguments indicate that the phase diagram belongs to the universality class of the Ashkin-Teller model and allow us to predict the critical behavior near the phase boundaries and at the multicritical point where they meet. Our lattice-gas-model calculations support these results. The predicted critical behavior, and thus the universality arguments, should be tested by additional experiments, in particular synchrotron-x-ray diffraction.

24135 **Spin correlations in a concentrated metallic spin-glass.** Aeppli, G.; Hauser, J.J.; Shirane, G.; Uemura, Y.J. (AT & T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **54**: No. 8, 843-846(25 Feb 1985). Contract AC02-76CH00016.

We have performed polarized- and unpolarized-neutron scattering measurements on amorphous MnSi. The results are consistent with bulk susceptibility data for the same sample, and show that a-MnSi behaves like the classical, dilute-moment spin-glass, CuMn. Relative to the spin-glass transition temperature, the energy scale for spin fluctuations is much larger in this material than in other concentrated spin-glasses.

24136 **Scaling of the metastability boundary of a d = 2 random-field Ising system.** Belanger, D.P.; King, A.R.; Jaccarino, V. (Department of Physics, University of California, Santa Cruz, California 95064 and Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **54**: No. 6, 577-580(11 Feb 1985). Contract AC02-76CH00016.

The H and T dependence of the magnetic Bragg peak intensity has revealed a relatively sharp metastability boundary T/sub F/(H) in a d = 2 random-field (RF) Ising system: Rb_2Co/sub 0.85/ Mg/sub 0.15/F_4. Remarkably, T/sub F/(H) scales as T/sub N/-T/ sub F/(H)proportionalH/sup 2/phi/, with the RF crossover exponent phi = 1.74 +- 0.02, and lies just inside the RF crossover region. Freezing must therefore be tied to RF critical behavior. The approach of the system to equilibrium at T/sub F/(H) proceeds logarithmically with time.

24137 **Pressure dependence of the superconducting transition temperature of LaT_4P_{12} (T = Fe, Ru, Os).** DeLong, L.E. (Kentucky Univ., Lexington (USA). Dept. of Physics and Astronomy); Meisner, G.P. (Los Alamos National Lab., NM (USA)). *Solid State Communications;* **53**: No. 2, 119-123(Jan 1985).

The superconducting transition temperature, Tsub(c), of the LaT_4P_{12} compounds with T = Fe, Ru, or Os has been measured under hydrostatic pressure P up to 1.8 GPa. The T = Fe compound exhibits a substantial increase of Tsub(c) from Tsub(c) (P-O) = 4.1 K at a rate (dTsub(c)/dP)sub(P=O) = $+7.2 \times 10^{-1}$ K/GPa. In contrast, the Ru and Os compounds exhibit only weak decreases of Tsub(c) from Tsub(c) (P=O) = 7.2 K and 1.8 K with (dTsub(c)/dP)sub(P=O) = -1.6×10^{-1} K/GPa and -9.5×10^{-2} K/GPa, respectively. An analysis of this strikingly divergent behavior of Tsub(c)(P) in terms of the structural characteristics of the RT_4X_{12} class of compounds where R = rare earth element, T = Fe, Ru, or Os, and X = P, As, or Sb suggests that Tsub(c)(P) for these materials consists of two competing contributions: a depression of Tsub(c) due to the compression of the lattice (i.e., decrease in volume), and an enhancement of Tsub(c) due to the effect of pressure on La itself.

24138 **Possible application of graphite-$SbCl_5$ intercalation compounds as long-wavelength neutron monochromators.** Eklund, P.C. (Kentucky Univ., Lexington (USA). Dept. of Physics and Astronomy); Smith, H.G. (Oak Ridge National Lab., TN (USA). Solid State Div.). *Journal of Applied Crystallography;* **17**: No. 6, 400-402(1 Dec 1984).

Neutron diffraction measurements on highly oriented pyrolytic graphite intercalated with $SbCl_5$ have been carried out and indicate that these intercalation compounds have practical application as long-wavelength neutron monochromators. This is due, in part, to their large d spacings and, in part, to their long-range c-axis stacking fidelity and chemical stability. The stage 2 compound is particularly suitable because it has intense first-order scattering accompanied by very weak second-order scattering. These intensity considerations are not as favorable for the stage 4 compound but applications at longer wavelenghts are possible. At a scattering angle of 60° (2theta) neutrons of wavelengths 12 x 8 and 19 x 5 A can be obtained from the stage 2 and stage 4 compounds, respectively. Structure-factor calculations for the 00l peaks are presented and are found to be in reasonable agreement with the diffraction data.

24139 **Microcrystalline structure of milled dolomite and its constituent carbonates.** Gammage, R.B.; Glasson, D.R.; Hodgson, I.R.; O'Neill, P. (Oak Ridge National Lab., TN). *Journal of Colloid and Interface Science;* **92**: No. 2, 530-544(Apr 1983). Contract W-7405-ENG-26.

The prolonged mechanical treatment of a small quantity of dolomite in a stainless-steel ball mill was insufficiently severe to cause disintegration into the component carbonate phases. Instead the dolomite was structurally degraded with the development of severe apparent lattice strain of about 4%, a unit cell dilated by about 0.6%, and locally misoriented carbonate ions. Contamination of the dolomite by wear fragments was slight, being at the rate of 10 ppm of Fe per hour. Similarly ground calcite and magnesite, in 1:1 mole ratio, underwent mechanochemical transformation to dolomite. Magnesite was gradually incorporated into microregions of the calcite at a rate that was first order with respect to the unconverted calcite. The apparent lattice strain in the mixed carbonate varied in a cyclic manner; the lattice strain normal to (104) planes was a maximum of about 8% when the magnesite content of the mixed carbonate was about 30 mole%. The d-spacing was then 2.973 A, which is about halfway between that of unstrained calcite, 3.035 A, and dolomite 2.904 A. Eventually all the calcite that had not transformed to aragonite was converted into dolomite. The microstructure then closely resembled that of dolomite which had been milled for a similar time. Ground calcite is soft enough to give nonporous aggregates of welded crystals. The crystals of the harder dolomite, and magnesite, fracture to produce less strongly welded aggregates with pores spanning the micro, meso, and macro size ranges. In doing so, the specific surfaces of the latter each pass through a maximum between 11 and 12 m^2/g after 20 hr of grinding.

24140 **Elastic neutron scattering results on $C_{24}Rb(D_2)$/ sub x/ in the dilute concentration regime.** Zabel, H.; Rush, J.J.; Magerl, A. (Univ. of Illinois, Urbana-Champaign). *Synthetic Metals;* **7**: 251-255(1983). Contract AC02-76ER01198.

The structure of D_2 molecules physisorbed in an oriented pyrolytic $C_{24}Rb$ sample at 80 K was studied by elastic neutron scattering. The low temperature diffraction pattern of pristine $C_{24}Rb$ changed dramatically upon sorption of D_2 molecules, and is consistent with the assumption of deuterium molecules decorating lattice gas-like interstitial sites within the alkali intercalant layer. These are presumably triangular sites associated with the alkali low temperature close-packed superstructure. 12 references, 4 figures.

24141 **Orthorhombic thorium(IV) molybdate, $Th(MoO_4)_2$.** Cremers, T.L.; Eller, P.G.; Penneman, R.A. (Los Alamos National Lab., NM). *Acta Crystallographica, Section C: Crystal Structure Communications;* **39**: 1165-1167(1983).

In marked contrast to the structure of hexagonal thorium(IV) molybdate, which contains both six- and nine-coordinate thorium, the orthorhombic form contains thorium in only one coordination environment. Thorium is coordinated to eight oxygen atoms from molybdate tetrahedra, in the form of a slightly distorted square antiprism. The Th-O distances range from 2.360 (4) to 2.459 (4) A [mean 2.403 (4) A]. The O-O-O angles and the O-O separations defining the two square faces range from 84.1 (2) to 98.1 (2)° and 2.780 (6) to 2.944 (6) A, respectively, while the separations within the triangular faces range from 2.915 (6) to 3.084 (6) A. The molybdate coordination is nearly regular tetrahedral, with Mo-O = 1.743 (4)-1.778 (4) A [mean 1.752 (4) A] and O-Mo-O = 106.4 (2)-111.8(2)°. Each oxygen is shared by one thorium and one molybdenum. This determination generally is consistent with the far-less-accurate determination reported by Thoret (1974), with marked improvement in the metal-oxygen distances. 9 references, 1 figure, 1 table.

24142 **(CE-Trans—7970) Problems of fine milling of hard minerals and how to solve them.** Guehne, H.; de Silva, S. Translated from *Aufbereitungs-Technik ;* No. 10, 472-480(1978). 30p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85901141. DE85901141

A mill, relatively recently introduced into Europe, is described which compared to mechanical comminution processes offers considerable advantages, especially in the fine- and superfine milling of hard and abrasive or thermosensitive materials. With one mill, by the simple expedient of changing the operating conditions on an integrated air classifier, it is possible to cover the size range from 98% passing 15 μm to under 200 μm. The very low wear encountered on this mill, even with hard minerals, allows its use for the production of contamination free powders, for example for the ceramic industry. A costing, based on a total installation, reveals comparable costs with conventional mills for coarser product specifications and offers an actual reduction where finer products are required. Since drying of free flowing materials takes place during the milling without additional equipment the mill offers yet another advantage over conventional design.

40 CHEMISTRY

REFER ALSO TO CITATION(S) 23829

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 23408, 23412, 23421, 23490, 23509, 23555, 23583, 23584, 24179, 24191, 24275

24143 **(ANL/ACL—85-1) Analytical Chemistry Laboratory progress report for FY 1984.** Green, D.W.; Heinrich, R.R.; Jensen, K.J.; Stetter, J.R. (Argonne National Lab., IL (USA)). Mar 1985. Contract W-31-109-ENG-38. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010150.

Technical and administrative activities of the Analytical Chemistry Laboratory (ACL) are reported for fiscal year 1984. The ACL is a full-cost-recovery service center, with the primary mission of providing a broad range of technical support services to the scientific and engineering programs at ANL. In addition, ACL conducts a research program in analytical chemistry, works on instrumental and methods development, and provides analytical services for governmental, educational, and industrial organizations. The ACL is administratively within the Chemical Technology Division, the principal user, but provides technical support for all of the technical divisions and programs at ANL. The ACL has three technical groups - Chemical Analysis, Instrumental Analysis, and Organic Analysis. Under technical activities 26 projects are briefly described. Under professional activities, a list is presented for publications and reports, oral presentations, awards and meetings attended. 6 figs., 2 tabs.

24144 **(CSIR-RR—559) Trace element distribution in different chemical fractions of False Bay sediments.** Rosental, R. (Council for Scientific and Industrial Research, Stellenbosch (South Africa). National Research Inst. for Oceanology). May 1984. 148p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85700879.

Includes maps and tables.

Trace metals in the aquatic environment are generally concentrated on solid geochemical phases which eventually become incorporated into estuarine and marine sediments. The mechanism of trace metal concentration is believed to be adsorption on various geochemical phases, such as hydrous metal oxides, clays and organic matter. Metals in estuarine sediments can thus be expected to be partitioned between different phases, depending on the concentration of the phase and the strength of the adsorption bond. The bioavailability of sediment-bound metals to deposit-feeding organisms will depend on trace metal partitioning and the kinetics of biological metal uptake from each geochemical phase. The major objective of this study was to establish an analytical procedure involving sequential chemical extractions for the partitioning of particulate trace metals in sediment samples, collected from False Bay. Eight metals were examined, i.e. Cd, Cu, Cr, Fe, Mn, Ni, Pb and Zn. X-ray diffraction was also used in the study.

24145 (DOE/ER/10275—1C, pp 1, Paper 42) **Comparison of commercially available liquid scintillation cocktails.** Munno, J. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Liquid scintillation spectroscopy is a very effective way to identify unknown sources of alpha and beta radiation. Currently many brands of liquid scintillation cocktails are available. This gives rise to the question, which is the best. The determination of which is best can be made through the use of experimental analysis. Seven different scintillation cocktails are compared on the basis of background, efficiency, and consistency.

24146 **(INIS-BR—153) Determination of rare earths and traces of other elements by neutron activation analysis.** Atalla, L.T.; Mantovani, M.S.M.; Marques, L.S.; Souza, M.A. de. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil)). [1985]. 32p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780844.

A complete methodology for a multielemental analysis in geological material using the neutron activation technique was developed. 21 trace elements (9 of which are rare earths) were determined using thermal and epithermal neutron irradiations. Instrumental and radiochemical processing, applied to BCR-1 and G-2 geological standards, are described. Statistical tests carried out on G-2 data show an error smaller than 15% referring to all elements except Cr, Sb and Yb. The observed differences between are discussed. The good precision attained in this method is confirmed by its application to BCR-1 standard, which presents errors smaller than 4% for all elements except Nd, due to its intrinsic properties. The results from the present work are compared with those from other laboratories.

24147 **(INIS-mf—9505) Studies of gas phase ion/molecule reactions by Fourier transform ion cyclotron resonance mass spectrometry.** Kleingeld, J.C. (Amsterdam Univ. (Netherlands)). 8 Feb 1984. 176p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780825.

Includes Dutch summary.

An important field in which Fourier-transform ion cyclotron resonance has useful applications is that of gas phase ion chemistry, the subject of this thesis. First, the general picture of ion-molecule reactions in the gas phase is discussed. Next, some positive ion-molecule reactions are described, whereas the remaining chapters deal with negative ion-molecule reactions. Most of these studies have been performed using the FT-ICR method. Reactions involving H_3O^- and NH_4^- ions are described whereas the other chapters deal with larger organic complexes.

24148 **(LBL—19254) Low-energy electron diffraction - experiment and theory.** Van Hove, M.A. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 15p. (CONF-8503126—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009967.

From 5. general conference of the Condensed Matter Division of the European Physical Society; Berlin, F.R. Germany (18 Mar 1985).

The current state of structure determination using Low-Energy Electron Diffraction (LEED) intensities is reviewed. Experimental and theoretical advances are examined, while lessons from successes and failures are discussed. The relationship between LEED and other techniques is also covered.

24149 **(ORNL—6139) Analytical Chemistry Division annual progress report for period ending December 31, 1984.** Lyon, W.S. (ed.). (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 97p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85010585.

Progress reports are presented for the following sections: analytical methodology; mass and emission spectroscopy; radioactive materials analysis; bio/organic analysis; and general and environmental analysis; quality assurance, safety, and tabulation analyses. In addition a list of publications and oral presentations and supplemental activities are included.

24150 **(PEL—285) Supplement to South African National Bibliography on Radioanalytical Chemistry: South African authors only. 1975-1982.** (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Jul 1984. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700877.

Compiled by Nucor library personnel for Subcommittee for Nuclear Technology; Consists of 190 refs. classified by date of publication and author.

The South African National Bibliography on Radioanalytical Chemistry was initiated by Dr Max Peisach of the National Accelerator Centre, Faure (formerly SUNI) and is intended to cover books, papers and reports published by South African scientists while affiliated to South African institutes, even if the work was carried out at foreign laboratories. The first edition (SUNI 56) covered material published to the end of 1977. The present edition is a supplement to the former and covers the period 1975 to 1982. The papers are divided into two categories. The first consists of papers on activation analysis, whether delayed or prompt and deals with the following: charged particle activation analysis, neutron activation analysis, photon activation and x-ray (including particle-induced x-ray emission, PIXE), prompt analysis and scattering, but is restricted to nuclear particle scattering. The second category deals with radioanalytical methods. To restrict the subject matter to those papers which stress the analytical approach and use nuclear techniques, this category has been sub-divided into the following subjects: absolute standardisation; computer techniques directly concerned with analysis; counting techniques for measuring radionuclides, nuclear particles or emissions; environmental monitoring related to the measurement of radioactive substances; instrumentation and techniques related to nuclear analytical methodology; isotope dilution analysis; low activity measurements; natural radioactivity counting; radiography; radiotracer methods excluding the routine diagnostic use of radionuclides in medicine and separation techniques. Titles are arranged in order of the year of publication, and with each year in alphabetical order of the surname of the first (and thereafter the next) author.

24151 **(SUNI—56) South African National Bibliography on Radioanalytical Chemistry to December 1977.** Peisach, M. (Southern Universities Nuclear Inst., Faure (South Africa)). [1977]. 101p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85700878.

Consists of 508 refs. classified by date of publication and author.

The bibliography covers publications on radioanalytical chemistry authored or co-authored by South Africans while affiliated to South African institutions even if the work was carried out at foreign laboratories. Author and subject indexes are included, the latter dividing the material into activation analysis, both delayed and prompt, and radioanalytical methods. The bibliography covers work published to the end of 1977.

24152 **Stable-isotope ratio analysis based on atomic hyperfine structure and optogalvanic spectroscopy.** Tong, W.G.; Yeung, E.S. (Iowa State Univ., of Science and Technology, Ames (USA). Dept. of Chemistry; Ames Lab., IA (USA)). *Talanta;* **31**: No. 9, 659-665(Sep 1984).

Atomic hyperfine structures were measured for the Cu I transition at 5782 A by optogalvanic spectroscopy at high resolution, with a cw dye laser. Samples were electro-deposited on the demountable cathode of a home-made hollow-cathode lamp. By spectral deconvolution, the relative isotopic abundances of ^{63}Cu and ^{65}Cu could be determined with good accuracy and precision. The technique is applicable to copper concentrations as low as 1.6 ppm.

24153 **Laser-excited shpolskii spectrometry.** D'Silva, A.P.; Fassel, V.A. (Ames Lab., IA). *Analytical Chemistry;* **56**: No. 8, 985A-1000A(Jul 1984). Contract W-7405-ENG-82.

Application of the site selective excitation technique to the quantitative chemical analysis of components of polycyclic aromatic hydrocarbons (PAH) in complex mixtures is reviewed. As one application, the luminescence of 4 individual PAHs in a solvent-refined coal liquid, is used. An alkane is usually used as a solvent. In contrast with other methods which require cumbersome separation processes, only a sample dilution step, the addition of an internal reference compound, and rapid cooling to 15°K are required prior to investigation. The authors are in the process of cataloging the excitation-emission spectra of PAHs. 62 references, 10 figures, 1 tables.

24154 **Phase plane method for deconvolution of luminescence decay data with a scattered-light component.** Love, J.C.; Demas, J.N. (Univ. of Virginia, Charlottesville). *Analytical Chemistry;* **56**: 82-85(1984).

A three-parameter version of the phase-plane method for deconvolution of luminescence decay data is presented that corrects for contributions of scattered excited light in the observed decay. Through computer simulations, we tested the method with numerous combinations of lifetimes, noise levels, and scatter coefficients. The modified equation was found to be computationally rapid and yielded excellent precision and accuracy in the decay parameters. 13 references, 4 figures, 1 table.

24155 **Removal of actinides from radioactive wastewaters by chemically modified peat.** Smith, C.M.; Navratil, J.D.; MacCarthy, P. (Rockwell International Corp., Rocky Flats Plant, Golden, CO; Colorado School of Mines, Golden). *Solvent Extraction and Ion Exchange;* **2**: No. 7-8, 1123-1149(1984).

Peat possesses a native cation exchange capacity and can thus bind to cations in the natural environment. Efforts to capitalize on this property of peat have been hampered by two major drawbacks: raw peat (1) is virtually impermeable to water, thereby precluding its use in a column mode; and (2) leaches severely and dissolves/suspends in water at pH >6. These disadvantages are minimized significantly by treating peat with concentrated sulfuric acid, resulting in a particulate material which is permeable to water and resistant to leaching. This product possesses an enhanced cation exchange capacity compared to the untreated peat, and is effective in removing a wide variety of cations from water. This paper discusses the effectiveness of modified peat in removing plutonium and americium from process wastewaters and compares the efficiency of this approach to more conventional methods for decontaminating radioactive wastewaters. The ability to elute bond plutonium and americium from the various adsorbents was also investigated in these experiments. 17 references, 12 figures, 4 tables.

24156 **Intra-alkali matrix effects in the inductively coupled plasma.** Faires, L.M.; Apel, C.T.; Niemczyk, T.M. (Los Alamos National Lab., NM). *Applied Spectroscopy;* **37**: No. 6, 558-563(1983).

Spatial profile studies are used to determine the interference effects of alkali matrix elements on the observed emission of alkali analyte elements in the inductively coupled plasma. These interferences are referred to as intra-alkali matrix effects. It is found that

significant enhancement of the analyte emission occurs low in the plasma in the initial radiation zone where atomic emission is most intense and that a slight downward shift in the vertical position of the emission peak is caused by the presence of the alkali matrix. A same value point occurs in the normal analytical zone where no net effect of the matrix on analyte emission is apparent. In the tail plume of the plasma, some lesser enhancement is again observed. The magnitude of the enhancement effect increases as the ionization potential of the matrix element decreases, and the effect appears linear with matrix concentration. The data suggest that the interference mechanism is related to an increase in electron density in the lower region of the plasma, and analytical correction for the interference is recommended for alkali determinations in the inductively coupled plasma. 17 references, 11 figures.

24157 **Extraction of copper, lead, zinc or cadmium ions sorbed on calcium carbonate.** Pickering, W.F. (Univ. of Newcastle, Australia). *Water, Air, and Soil Pollution;* **20**: 299-309(1983).

The amount of sorbed metal ion released from $CaCO_3$ by 16 different extractants was found to vary with the chemical nature of the solution and the metal ion involved. In general, acid solutions dissolved a high proportion of both substrate and Cu, Pb, Cd coatings; complexing agents dissolved the same coatings but left most of the calcite; and competing cations (e.g. NH_4^+, Ca^{2+}) displaced primarily chemisorbed Cd and Cu. In Zn studies, little metal ion was retrieved by any extractant due to the limited solubility of the coatings formed at pH $<$ 7.7. The diverse behavior observed in the sorption studies has been interpreted in terms of solubility and absorption equilibria. The pH of the $CaCO_3$ suspensions was high enough to precipitate all added Pb as hydroxy species, and excess Cu tended to precipitate at pH $>$ 6.4 if one increased the soluble carbonate level (e.g. by adding acid). Unlike Cd and Cu, Zn was not chemisorbed; it formed sparingly soluble compounds such as $ZnCO_3$ $2Zn(OH)_2$, with excess coming out as $Zn(OH)_2$ at pH $>$ 7.7. The significance of the results in respect to the mobility of metal ions in calcareous soils, and the evaluation of available levels, has been considered.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 23559, 23594, 24140, 24170, 24171, 24190, 24551, 24594, 24595, 24596, 24838

24158 **(DOE/ER/13131—T1) Highly dispersed metal atoms in zeolites. Progress report.** Suib, S.L. (Connecticut Univ., Storrs (USA). Dept. of Chemistry). 15 Apr 1985. Contract AC02-83ER13131. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010515.

Our studies this past year have involved work in the following areas: preparation of highly dispersed metal atoms in molecular sieves via microwave discharge methods, hydroformylation of l-pentene with rhodium zeolites and Rutherford backscattering studies of zeolites. The microwave discharge method has been developed by us to provide a synthetic route to produce highly dispersed iron and cobalt atom clusters in several molecular sieves such as zeolites, aluminophosphates, pillared clays and clays. We have done ferromagnetic resonance, infrared, Mossbauer and scanning electron microscopy experiments on these materials. Generalizations that can be made so far are that these particles are extremely small, reactive and their formation is governed by the type of support. They are all active in Fischer-Tropsch reactions although cobalt materials are more selective and stable than iron materials. Superparamagnetic iron clusters have been observed for the incorporation of iron into zeolites, ALPO's and pillared clays. These results are unique in that iron (0) is usually oxidized in a zeolite environment. The second project deals with Wilkinson's catalyst and the preparation of phosphine rhodium zeolite catalysts. These catalysts are selective towards aldehyde formation and the normal to branched aldehyde ratio can be controlled. EXAFS, Fourier transform infrared and x-ray powder diffraction experiments have been carried out on these catalysts. The third project deals with Rutherford backscattering studies of zeolites. We have shown that Rutherford backscattering methods can be used to distinguish metal ions on the surface of a porous support from internal metal ions exchanged into the pores of the support.

24159 **(IAE—3556/13) Chemical method for determination of atomic fluorine flows at low temperature.** Bezmel'nitsyn, V.N.; Spirin, S.N.; Chajvanov, B.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700880.

A new method for determination of atomic fluorine flows from the Krsub(sol)+2F → KrF_2 reaction at 77 K has been developed. The kinetics of krypton difluoride formation in this reaction is studied. The atomic fluorine flows from the surface of a heated catalyst and the energetic efficiency of the process of catalytic molecular fluorine dissociation are determined in the 786-873 K temperature range and 5-40 torr pressure range.

24160 **(INIS-mf—9275) Vapor phase hydrolysis of promethium (III) bromide.** Theissig, W. (Muenchen Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie). 1983. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780845.

The paper marks the beginning of a large-scale research project on promethium chemistry. There is a wide scope for further research as little is known of the compounds and thermodynamic data of element 61. Promethium is produced in large amounts as a decay product of reactor fuel rods. It can be obtained at low cost, and its potential technical applications are interesting (power generation, reactor chemistry, luminous substances).

24161 (INIS-mf—9510, pp 86-89, 143-146) **Isotopic clusters. Section IV.6.** Geraedts, J.M.P. 23 Sep 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780824.

In Infrared excitation of clusters.

Spectra of isotopically mixed clusters (dimers of SF_6) are calculated as well as transition frequencies. The result leads to speculations about the suitability of the laser-cluster fragmentation process for isotope separation.

24162 **(INIS-mf—9510) Infrared excitation of clusters.** (Katholieke Univ. Nijmegen (Netherlands)). 23 Sep 1983. 169p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780824.

Individual sections were abstracted separately.

24163 **Halide-promoted insertion of CO into bridging-methylene ligands in triosmium clusters.** Morrison, E.D.; Geoffroy, G.L.; Rheingold, A.L. (Pennsylvania State Univ., University Park). *Journal of the American Chemical Society;* **107**: No. 1, 254-255(9 Jan 1985).

The starting complexes have the formula $[PPN][Os_3(CO)_{10}(\mu\text{-}CH_2)(\mu\text{-}X)]$. PPN-(triphenylphosphine)$_2$N$^+$; X = Cl, Br, I, or NCO. These complexes react in less than 1 min to form the ketene clusters. Such a reaction without the halide ligand requires 4 h to go to completion. The most interesting finding of the study is the accelerating effect of the X ligands. 15 references, 2 figures.

24164 **Kinetics and mechanism of molecular A-frame formation in reactions of $[Pt_2(PPh_3)_2(\mu\text{-}dppm)_2](PF_6)_2$ with diazomethane, carbon monoxide, sulfur dioxide, sulfur, and hydrogen chloride.** Muralidharan, S.; Espenson, J.H. (Iowa State Univ., Ames). *Journal of the American Chemical Society;* **106**: No. 26, 8104-8109(26 Dec 1984). Contract W-7405-ENG-82.

The mechanism of the formation of A frames of the type $[Pt_2(PPh_3$ triphenylphosphine$)_2(\mu\text{-}Y)(\mu\text{-}dppm)_2](PF_6)_2$ (y = CH_2, CO, S, SO_2) from $[Pt_2(PPh_3)_2(\mu\text{-}dppm)_2](PF_6)_2$ by reaction with CH_2N_2, CO, S, and SO_2 (R) in CH_2Cl_2 and other organic solvents has been investigated by using kinetic studies and product analysis. Pseudo-first-order kinetic data (excess $[R]_0$) are consistent with either preequilibrium association of R with the complex prior to rate-limiting product formation or unimolecular formation of a common intermediate which is then attacked by R to form the A-frame product. Kinetic studies with $[R]_0 \leqq [complex]_0$ substantiate the latter. The most likely intermediate leading to the products is one with a dangling dppm ligand formed by Pt-P bond heterolysis. When $[R]_0$ is very large, formation of this intermediate becomes rate limiting and is independent of the nature of R, with k = 2.73

+/- 0.05 x 10^{-2} s^{-1} (at 25°C; ΔH = 25.0 kcal mol^{-1} and ΔS = 18.5 cal mol^{-1} K^{-1}). The same process and mechanism is observed for R = HCl, although with minor numerical differences; similar salt and solvent polarity effects occur in all of the reactions [dppm-bis(diphenylphosphino)methane]. 23 references, 1 figure, 3 tables.

24165 **Radiation pattern of fluorescence from molecules embedded in small particles: general case.** Druger, S.D.; McNulty, P.J. (Clarkson College of Technology, Potsdam, NY). *Applied Optics;* 22: No. 1, 75-82(1 Jan 1983). Contract AC02-77EV04361.

A method is presented for calculating and analyzing the angular distribution of fluorescent emission from randomly oriented anisotropic molecules embedded in small dielectric partices with the nonzero reorientation angle between absorption and emission moments suggested by physical considerations now taken into account. Calculations performed on the basis of this method are compared with some of the available experimental data for fluorescent dye molecules embedded in microspheres, and good quantitative agreement is found. It is shown how fitting the computed results to experimental data determines an effective reorientation angle between absorption and emission transition moments. A more definitive test to which the model could be subjected is described. 15 references, 6 figures, 1 table.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 23553, 24105, 24158, 24163, 24164, 24194, 24370, 24371, 24372, 24373, 24549

24166 **(DOE/BC/10476—12) Vapor pressure studies of the solubilization of hydrocarbons by surfactant micelles. Final report, April 1, 1984-December 31, 1984.** Christian, S.D.; Tucker, E.E. (Oklahoma Univ., Norman (USA). Dept. of Chemistry). Apr 1985. Contract AT19-81BC10476. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85000124.

This final report describes vapor pressure studies of the solubilization of hydrocarbons and hydrocarbon derivatives by aqueous micellar solutions. An automated vapor pressure apparatus and a manual apparatus incorporating a mercury-covered sintered-glass disk inlet valve were used to obtain highly precise data for the solubilization of hydrocarbons and aliphatic alcohols into aqueous solutions of the ionic surfactants sodium octylsulfate and n-hexadecylpyridinium chloride (cetylpyridinium chloride). A mass-action model based on a modification of the Poisson distribution equations has been developed and applied to data for the system benzene/sodium octylsulfate/sodium chloride/water at 15°, 25°, 35°, and 45°C. An excellent goodness of fit is achieved with the model. Tabulated experimental results (485 sets of activity and concentration data) are included in this report. 12 references, 2 figures.

24167 **(DOE/ER/10689—5) Reactions of metal ions and their clusters in the gas phase using laser ionization-ion cyclotron resonance spectroscopy. Progress report, July 1, 1984-June 30, 1985.** Freiser, B.S. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). Mar 1985. Contract AC02-80ER10689. 47p. (CONF-8505123—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009478.

From ASMS annual conference on mass spectrometry and applied topics; San Diego, CA, USA (1 May 1985).

Recent developments in our laboratory involving both software and hardware modifications of the Nicolet FTMS-1000 Fourier transform mass spectrometer now enable us to conduct research in what can be properly termed a complete gas phase chemical laboratory. Selected ions of interest can be mixed with various reagents and their detailed chemistries monitored through a series of as many as eight reaction sequences. At any point in these sequences, ion structures can be elucidated and fundamental kinetic and thermodynamic parameters of the reactions can be determined. In particular we have been applying these powerful new techniques to examine the gas phase chemistry and photochemistry of metal ions, metal clusters and metal complexes, all of which have a bearing on the fundamentals of organometallic chemistry and catalysis. In this report some of the highlights of this work will be presented. 37 references, 13 figures, 2 tables.

24168 **(DOE/ER/13126—1) [New polymer electrodes]. Technical progress report.** (Case Western Reserve Univ., Cleveland, OH (USA)). 1985. Contract AC02-83ER13126. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010297.

The focus of the research has been on the establishment of a reliable procedure for the synthesis of high-purity polyhydroquinones. As has been correctly pointed out by the previous reviewers of this work, the polyhydroquinone synthesis has not been successfully accomplished in the past. In order to attack this difficult problem, our group focused on two different methods of synthesis: (a) the use of cyanoacetic acid (CAA) coupled with hydroquinone (HQ), and (b) the use of trioxane (TN) coupled with HQ. Both methods are essentially one step procedures, which assure easy scale-up to commercial scale operations. The following conclusions were reached: polyhydroquinone can be synthesized according to the mentioned reactions, provided the reaction conditions are controlled carefully; the product formed can be easily isolated from the sulpholane as the same is highly miscible with water; the polymer can be made to remain in solution. This should assist us in further characterization like viscosity measurements, polydispersity, molecular weight determination, processing of fibers, mechanical properties, etc. 28 references, 2 figures, 1 table.

24169 **(DOE/PC/30229—7) Thermal reactions of aromatics with CaO. Final report.** Longwell, J.P.; Ellig, D.L.; Lai, C.K.; Mead, D.W.; Williams, G.C.; Peters, W.A. (Massachusetts Inst. of Tech., Cambridge (USA)). May 1985. Contract FG22-80PC30229. 49p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010688.

The pyrolysis of benzene, toluene, 1-methylnaphthalene, 1-methylanthracene, 9-methylanthracene, m-cresol, and n-heptane was studied over CaO and quartz in a fixed-bed reactor under atmosphere pressure. The reaction temperature spanned the range of 350 to 900°C with vapor phase residence time kept between 1 and 2 seconds. Compared to quartz, CaO significantly increased the rates and extents of pyrolysis of the aromatic hydrocarbons, reducing the temperature for a given amount of conversion by at least 100°C. The magnitude of this enhancement effect increased with increasing aromaticity, or molecular size, of the compounds. For the light aliphatic, n-heptane, the effect of CaO is minor, with pyrolysis results similar to those observed over quartz and in vapor phase cracking. Coke was the major product for pyrolysis of aromatic compounds over either solid. Detailed examination of the distribution of the volatile products suggests that: (1) condensation reactions were the major pyrolysis reactions over CaO, and (2) some of the active sites on the CaO surface may be related to anion defects in the CaO lattice. CaO deactivation studies show that coke deposits from pyrolysis quickly destroy the CaO activity. Oxygen burnoff of the coke at temperatures between 650 and 800°C regenerated 70 to 80% of the initial CaO activity. Pyrolysis of m-cresol on CaO surfaces exhibited acid-base behavior over the temperature range 0 to 550°C. The initial pyrolysis rate was rapid but formation of calcium salts of cresol, which have much larger molar volumes than the substrate limited the accessibility of reactant gas to the inner unreacted surface, thus drastically reducing the overall rate of conversion with increasing stone utilization. At temperatures above 550°C, these calcium salts decomposed to yield coke, CO, H_2O and other light hydrocarbon gases. 20 refs., 26 figs., 4 tabs.

24170 **Pressure-dependent electron attachment and breakdown strengths of unary gases and synergism of binary gas mixtures: A relationship.** Hunter, S.R.; Christophorou, L.G. (Atomic, Molecular, and High Voltage Physics Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* 57: No. 9, 4377-4385(1 May 1985). Contract AC05-84OR21400.

The relationship between the pressure-dependent electron attachment rate constants which have been observed in 1-C_6F_6 and in several perfluoroalkanes and the uniform field breakdown strengths (E/N)/sub lim/ in these gases is discussed. Also discussed are the various types of synergistic behavior in (E/N)/sub lim/ which have been observed in binary dielectric gas mixtures. For the latter, a new mechanism is outlined which explains the synergism observed

in several gas mixtures where the (E/N)/sub lim/ values of the mixtures are greater than those of the individual gas constituents, which we call positive synergism. Model calculations are presented which support this mechanism and can be used to explain the pressure-dependent synergistic effects which have been reported in 1-C_3F_6/SF_6 and other gas mixtures. Experimentally observed ion—molecule reaction processes for several gases are discussed which support the proposed mechanism. Based on this mechanism, we outline several conditions which must be fulfilled in order to observe positive synergistic behavior in dielectric gas mixtures.

24171 **Reactions of $FeCH_3i$ and $CoCH_3^+$ with cyclic alkanes in the gas phase.** Jacobson, D.B.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **107**: No. 1, 67-72(9 Jan 1985). Contract AC02-80ER10689.

Gas-phase reactions of the title carbenes with cyclic alkanes with use of Fourier transform mass spectrometry (FTMS) are described. The metal-carbene reacts with both cyclopropane and cyclobutane by initial C-C bond insertion. The methylidene-metallacyclobutane species produced from cyclopropane appears to decompose by three pathways: (1) cleavage of the metallacyclobutane ring (olefin metathesis), (2) ring expansion by carbene/alkyl coupling, and (3) β-hydride abstraction. With cyclobutane, an $MC_6H_6^+$ ion is produced which consists of cyclopentadiene bound to the metal ion. For cyclopentane and cyclohexane, initial insertion into C-H bonds dominates generating M(cyclic olefin)$^+$ species. Small amounts of $M(C_4H_8)^+$ and $M(C_7H_8)^+$ were also produced from cyclopentane and cyclohexane, respectively, and are assigned as M(MCP)$^+$ (MCP = methylcyclopentadiene) and M(tol)$^+$ (tol = toluene). 62 references, 1 figure, 2 tables.

24172 **Dynamics of monoolefin-metal ion complexes in the gas phase: determination of the number of labile hydrogens by reaction with C_2D_4.** Jacobson, D.B.; Freiser, B.S. (Purdue Univ., West Layfayette, IN). *Journal of the American Chemical Society;* **107**: No. 1, 72-80(9 Jan 1985). Contract AC02-80ER10689.

H/D exchange reactions of organometallic ions with D_2 in the gas phase have proven valuable in determining the number of labile hydrogens in the complex. Unfortunately, many complexes are not observed to exchange with D_2. In this paper we demonstrate that C_2D_4 can extend the variety of complexes which may be studied. The propene complexes of Fe^+, Co^+, and Ni^+ which are unreactive with D_2 undergo 5 H/D exchanges with C_2D_4. These results are rationalized by invoking an equilibrium between the propene and hydrido-π-allyl species promoted by the activation afforded by ethene-d_4 coordination. The Rh(propene)$^+$ complex is observed to exchange all 6 hydrogens suggesting an additional mechanism involving a vinylic C-H bond insertion. In addition, this Rh(propene)$^+$ species undergoes multiple exchangers per C_2D_4 encounter in contrast to the M(propene)$^+$ species of Fe^+, Co^+, and Ni^+ which undergo only a single exchange per C_2D_4 encounter. The rate of the above exchanges falls into the order $Rh^+ > Co^+ > Fe^+ > Ni^+$. Rh(1,3-pentadiene)$^+$ undergoes 5 rapid exchanges with C_2D_4 while the corresponding iron and cobalt complexes yield 5 slow exchanges with no exchange observed for the nickel complex. No multiple exchanges occur for these pentadiene ions. The isomeric Rh(2-methylbutadiene)$^+$ species undergoes 5 slow exchanges with none observed for the iron, cobalt, and nickel species. M-c-$C_6H_6^+$ (M = Fe, Co, Ni) undergo 6 rapid exchanges with multiple exchanges predominating. The Rh-c-$C_6H_6^+$ species only undergoes one rapid exchange. Both Rh-c-$C_7H_8^+$ and Co-c-$C_7H_8^+$ generated from cycloheptatriene yield one slow exchange with C_2D_4 with none observed for Fe-c-$C_7H_8^+$ and Ni-c-$C_7H_8^+$. 69 references, 8 figures.

24173 **Toward the laboratory identification of cyclopropenylidene.** Lee, T.J.; Bunge, A.; Schaefer, H.F. III. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **107**: No. 1, 137-142(9 Jan 1985). Contract AC03-76SF00098.

Nonempirical molecular electronic structure theory has been used to predict the geometries and energetics of the lowest singlet and triplet states of C-HC=CH. The closed-shell singlet ground state is predicted to lie about 70 kcal/mol below the lowest triplet state. Actually there are two low-lying triplet states, $^3B_1$ and $^3A_2$, which lie very close energetically. Ground-state cyclopropenylidene is predicted to have a dipole moment $\mu \sim 3.4$ D, making it a very nucleophilic carbene. Vibrational frequencies are predicted for all three low-lying electronic states at the double-zeta plus polarization (DZ+P) self-consistent-field (SCF) or two-configuration (TC) SCF levels of theory. A comparison of the predicted harmonic frequencies of singlet cyclopropenylidene and cyclopropene at the SCF level of theory is made. These predictions should assist in the identification of cyclopropenylidene from matrix-isolation ir spectroscopy. 37 references, 3 figures, 8 tables.

24174 **Stability constants, enthalpies, and entropies for metal ion-lariat ether interactions in methanol solution.** Davidson, R.B.; Izatt, R.M.; Christensen, J.J.; Schultz, R.A.; Dishong, D.M.; Gokel, G.W. (Brigham Young Univ., Provo, UT). *Journal of Organic Chemistry;* **49**: No. 26, 5080-5084(28 Dec 1984). Contract AC02-78ER05016.

Log K/sub n/, ΔH/sub n/, and TΔS/sub n/ values valid in CH_3OH at 25°C have been determined for the interaction of Na^+, K^+, Cs^+, and Ca^{2+} with 15-crown-5 and several lariat ethers. The lariat ethers studied are based on both 15-crown-5 and 18-crown-6 frameworks and contain various pendant arms extending from either carbon or nitrogen atoms on the crown framework. In comparable cases, enlarging the ring size from 15 to 18 members resulted in increased stability. The inclusion on the aza-15-crown-5 ring of a pendant arm bound to nitrogen and having an oxygen atom in the 3 position increases complex stability. The inclusion on the aza-15-crown-5 ring of a pendant arm bound to nitrogen and having an oxygen atom in the 3 position increases complex stability about tenfold for Na^+, K^+, and Ca^{2+} compared to the crown ether with the same ring structure but lacking a heteroatom in the side arm. Generally, little effect on the log K/sub n/ value is found either by lengthening the pendant arm (and by including an additional donor atom) on the 18-crown-6 compounds or by appending pendant arms having oxygen atoms on the carbon pivot atom of the 15-crown-5 macrocycles. 25 references, 1 figure, 2 tables.

24175 **Nucleophilic substitution at centers other than carbon: reaction at the chlorine of N-chloroacetanilides with triethylamine as the nucleophile.** Underwood, G.R.; Dietze, P.E. (New York Univ., NY). *Journal of Organic Chemistry;* **49**: No. 26, 5225-5229(28 Dec 1984). Contract AC02-81ER60015.

The reaction between triethylamine (TEA) and a series of para-substituted N-chloroacetanilides has been studied in aqueous solution buffered to pHs between 1 and 5. The exclusive product derived from the aromatic moiety is the corresponding acetanilide. The reaction occurs via two parallel pseudo-second-order paths, one acid catalyzed (the Orton-like mechanism), the other uncatalyzed. The uncatalyzed reaction is accelerated by the presence of electron-withdrawing substituents on the aromatic ring and can best be represented as nucleophilic displacement at chlorine. It therefore appears to be the prototype of a convenient class of reactions for the study of displacement reactions at chlorine. The rho value for this reaction is 3.87, indicating substantial negative charge buildup in the aromatic ring during of the transition state. The acid-catalyzed reaction is more complex, presumable involving a protonation equilibrium for the N-chloroacetanilide prior to the rate-determining step similar to that in the Orton reaction. 15 references, 2 figures, 3 tables.

24176 **Direct formation of organocopper compounds by oxidative addition of zerovalent copper to organic halides.** Ebert, G.W.; Rieke, R.D. (Univ. of Nebraska, Lincoln). *Journal of Organic Chemistry;* **49**: No. 26, 5280-5282(28 Dec 1984). Contract AC02-80ER10603.

A very reactive copper species is produced by reduction of $CuI.P(C_6H_5)_3$ with a stoichiometric of lithium naphthalide in tetrahydrofuran. The copper undergoes rapid oxidative reactions with allyl, aryl, and vinyl halides. The results are summarized. 15 references, 3 tables.

24177 Photoelectron spectroscopy of the allylic anion. Oakes, J.M.; Ellison, G.B. (Univ. of Colorado, Boulder). *Journal of the American Chemical Society;* **106**: No. 25, 7734-7741(12 Dec 1984). Contract AC02-80ER10722.

The authors have examined the photodetachment spectra of the allylic anion ($CH_2CHCH_2^-$) and two of its deuterated isotopes, $CH_2CDCH_2^-$ and $CD_2CDCD_2^-$. The electron affinities (EA) of the corresponding allyl radicals are EA(CH_2CHCH_2) = 0.362 +/- 0.020 eV, EA(CH_2CDCH_2) = 0.373 +/- 0.020 eV, and EA(CD_2CDCD_2) = 0.381 +/- 0.026 eV. The photoelectron spectra of these ions show only one active vibronic mode which the authors assign as the in-plane C-C-C bend. This leads them to conclude that the anion has a planar, symmetric C/sub 2v/ geometry. Computational modeling yields a geometry for the $CH_2CHCH_2^-$ ion with a C-C-C bond angle 16° greater than that of the allyl radical. 41 references, 9 figures, 5 tables.

24178 Methyl-group and deuterium-atom labeling in the mechanism of the rearrangement of benzocyclobutene to styrene. Trahanovsky, W.S.; Scribner, M.E. (Iowa State Univ., Ames). *Journal of the American Chemical Society;* **106**: No. 25, 7976-7978(12 Dec 1984). Contract W-7405-ENG-82.

Pyrolysis of benzocyclobutene produces styrene. Evidence is presented to show that the rearrangement involves a series of arylcarbene-cycloheptatetraene conversions. 14 references.

24179 Angle-resolved photoelectron spectroscopy of benzene and hexafluorobenzene as a function of photon energy. Mehaffy, D.; Keller, P.R.; Taylor, J.W.; Carlson, T.A.; Grimm, F.A. (Univ. of Wisconsin, Madison). *Journal of Electron Spectroscopy and Related Phenomena;* **28**: 239-247(1983). Contract W-7405-ENG-26.

Angle-resolved photoelectron spectra of benzene were recorded using synchrotron radiation as the photon source. From these results the angular distribution parameter β was extracted for the first three orbitals; 1e/sub 1g/(π), 3e/sub 2g/(σ) and 1a/sub 2u/(π). Calculations of β employing the MS Xα method were also carried out. Agreement between experiment and theory for the first two orbitals is excellent. Poor agreement in the core of the third orbital is believed to be due to overlap of the second and third bands in the photoelectron spectra. This has been verified by data obtained for perfluorobenzene. The universality of the energy dependence of β for π orbitals, noted previously for unsaturated aliphatic compounds, has been extended to aromatic systems. The importance of the results for benzene for the future application of angle-resolved photoelectron spectroscopy to complex molecules is indicated. 20 references, 6 figures.

4005 Photochemistry

REFER ALSO TO CITATION(S) 24154, 24167, 24184

24180 (LA-UR—85-1097) Vibrational energy transfer in benzene-argon collisions. Lyman, J.L.; Mueller, G.; Houston, P.L.; Piltch, M.; Schmid, W.E.; Kompa, K.L. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 18p. (CONF-850345—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009603.

From Southwest conference on optics; Albuquerque, NM, USA (4 Mar 1985).

This paper reports the results of an extensive study of the internal energy-transfer processes that occur in benzene-argon collisions. We used laser-induced fluorescence and information theory for determining the energy-transfer rates between internal states of benzene in the ground electronic state. The use of information theory gives estimates for all of the vibrational energy transfer rates. These fit the experimental data reasonably well. However, some of the data do deviate from the information theory model. This suggests that the statistical assumptions of the model are not sufficiently restrictive. One such restriction may be in the number of vibration quantum numbers that change in a collisional event. The rates of vibrational energy transfer depend strongly on the vibrational energy defect. 5 references, 8 figures, 3 tables.

24181 (SAND—84-1956C) Self-developing polysilane deep-uv resists - photochemistry, photophysics, and submicron lithography. Zeigler, J.M.; Harrah, L.A.; Johnson, A.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 21p. (CONF-8503124—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85007608.

From SPIE symposium on microlithography; Santa Clara, CA, USA (10 Mar 1985).

A new class of alkyl silane copolymers with relatively facile self-developing behavior under deep uv exposure has been examined. These materials can reproduce 0.8 μ features by projection lithography with a KrF excimer light source. The mechanism of material removal is primarily photochemical in nature and yields chemically inert volatile siloxanes as the major photoproducts, via a high quantum yield silylene expulsion/oxidation process. 21 reference, 12 figures, 1 table.

24182 Photophysics and photochemistry of arylmethyl radicals in liquids. Bromberg, A.; Schmidt, K.H.; Meisel, D. (Argonne National Lab., IL). *Journal of the American Chemical Society;* **107**: No. 1, 83-91(9 Jan 1985). Contract W-31-109-ENG-38.

A series of arylmethyl radicals (including Ph_2CH (diphenylmethyl), 10,11-dihydro-5H-dibenzo[a,d]cyclohepten-5-yl (=DBHP.), Ph_2CCH_3, Ph_2C-c-Pr, and Ph_2C.) have been produced pulse radiolytically in a variety of solvents and then excited with λ = 347 nm ruby laser pulses. Ph_2CCH_3, Ph_2C-c-Pr, and Ph_2C undergo a solvent independent monophotonic photochemical reaction with high quantum yield. This reaction is proposed to occur from the first excited doublet state and to yield a fluorenyl-type radical. Ph_2CH and DBHP strongly fluoresce upon relaxation to their ground doublet state. Fluorescence spectra as well as excited doublet-doublet absorption spectra of these radicals have been recorded and their lifetimes and fluorescence quantum yields determined. No photochemistry is observed from the lowest excited state of both of these radicals. The difference in photoreactivity of the two groups of radicals (Ph_2CH and DBHP vs. Ph_2CCH_3, PH_2C-c-Pr, and Ph_2C) is rationalized as resulting from the degree of twist of the phenyl groups out of the central molecular plane. A solvent-dependent consecutive biphotonic photochemistry from excited states higher than the lowest excited doublet state is, however, observed for the Ph_2CH and DBHP radicals. A mechanism to rationalize this photochemistry is proposed. 26 references, 12 figures, 1 table.

24183 Infrared laser photochemistry of SiH_4-HCl mixtures. Moore, C.B.; Biedrzycki, J.; Lampe, F.W. (Pennsylvania State Univ., University Park). *Journal of the American Chemical Society;* **106**: No. 25, 7761-7765(12 Dec 1984). Contract AC02-76ER03416.

The ir laser photochemistry of SiH_4-HCl mixtures has been studied in a pressure range of 28-60 torr and in a temperature range of 295-414 K. The gaseous products observed are H_2, Si_2H_6, SiH_3Cl, SiH_2Cl_2, and $SiHCl_3$ with trace amounts of Si_3H_8 and Si_2H_5Cl. As is usual in silane decompositions, a solid product containing silicon, hydrogen, and perhaps very small amounts of chlorine was also formed. The photochemical conversion is best described by initial decomposition of SiH_4 to SiH_2 and H_2 followed by competition of SiH_4 and HCl for SiH_2 molecules. The simultaneous formation of all chlorosilanes suggests that decomposition of the initial product of SiH_2-HCl reaction leads in turn to SiHCl and $SiCl_2$ molecules. Studies of the temperature dependence of the rates of the competing reactions indicate that the activation energy for insertion of SiH_2 into HCl is less than 1.3 kcal/mol. 23 references, 8 figures, 1 table.

4006 Radiation Chemistry

24184 (DOE/ER/12042—3) Unified approach to characterization of collisions between reactive radical pairs in solution. Technical progress report. (Brown Univ., Providence, RI (USA)). [1985]. Contract AC02-82ER12042. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010441.

The principal results obtained during the reporting period were as follows: (1) Procedures for systematically determining elec-

tron spin-lattice relaxation times for reactive radicals have been developed and applied to a series of simple radicals produced by electron radiolysis of aqueous solutions. It is concluded that relaxation in these radicals is best accounted for by the spin-rotation mechanism. (2) Measurements of the ratio of Heisenberg exchange to radical recombination rates have been carried out for 6 radicals using determination of the transverse relaxation time at high radical concentrations. In all cases the exchange is faster than recombination. (3) Several modifications of the van de Graaff/pulsed epr system at Argonne have improved the sensitivity, reliability, and ease of operation of the system. (4) Steady state epr has been obtained from methyl radical generated by photolysis of a readily available mixed diacyl peroxide. (5) Heisenberg exchange and dimerization rate constants have been compared for triphenylmethyl radical. The rate difference of more than one million is in marked contrast to those for the series of highly reactive radicals described in (2) above. 2 figs., 1 tab.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 23578, 23589, 23775

24185 **(CONF-841210—22) Thermodynamic systematics of oxides of americium, curium, and neighboring elements.** Morss, L.R. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009704.

From International chemical congress of Pacific Basin Society; Honolulu, HI, USA (16 Dec 1984).

Recently-obtained calorimetric data on the sesquioxides and dioxides of americium and curium are summarized. These data are combined with other properties of the actinide elements to elucidate the stability relationships among these oxides and to predict the behavior of neighboring actinide oxides. 45 references, 4 figures, 5 tables.

24186 **(INIS-mf—9276) Neptunium sulfates.** Hellmann, H. (Muenchen Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie). 1983. 74p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780846.

The author of the dissertation was able to prepare a number of hitherto unknown Np(VI) double sulphates and to characterize all substances by powder radiography. In the 400 to 800°C range, the salts decomposed, and SO_3 was released. The reaction products were either defined alkali/Np mixed oxides or NpO_2 with, in some cases, admixtures of another phase. In a few cases, it was possible to synthesize analogous uranium compounds and to study these by radiographic methods.

24187 **(INIS-mf—9277) Investigations on uranyl nitrate solubility in nitric acid in different concentrations at temperatures of 5°C.** Deigele, E. (Muenchen Univ. (Germany, F.R.)). 1983. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780847.

The solubility of uranyl nitrate was studied in nitric acid solutions of different concentrations at a temperature of 5°C. This temperature was chosen with a view to using water as coolant and to facilitate the handling of the strong acid solutions. Accurate curves were established by a multitude of accurate measurements in the high concentration range. Further solubility curves can be derived from this basic curve. Some of the precipitates in the interesting regions of the solubility curve were analyzed.

24188 **(INIS-mf—9281) Investigations on the oxidation of nitric acid plutonium solutions with ozone.** Boehm, M. (Muenchen Univ. (Germany, F.R.)). 1983. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780848.

The reaction of ozone with nitric acid Pu solutions was studied as a function of reaction time, acid concentration and Pu concentration. Strong nitric acid Pu solutions are important in nuclear fuel element production and reprocessing. The Pu must be converted into hexavalent Pu before precipitation from the homogeneous solution together with uranium-IV, ammonia and CO_2 in the form of ammonium uranyl/plutonyl carbonate (AUPuC). Formation of a solid phase during ozonation was observed for the first time. The proneness to solidification increases with incrasing plutonium concentrations and with decreasing acid concentrations. If the formation of a solid phase during ozonation of nitric acid Pu solutions cannot be prevented, the PU-IV oxidation process described is unsuitable for industrial purposes as Pu solutions in industrial processes have much higher concentrations than the solutions used in the present investigation.

24189 **Syntheses and specific activity determination of no-carrier-added fluorine-18-labeled neuroleptic drugs.** Shiue, C.Y.; Fowler, J.S.; Wolf, A.P.; Watanabe, M.; Arnett, C.D. (Brookhaven National Lab., Upton, NY). *Journal of Nuclear Medicine;* **26**: No. 2, 181-186(Feb 1985). Contract AC02-76CH00016.

A general method for the syntheses of no-carrier-added (NCA) ^{18}F-labeled butyrophenone neutroleptics - benperidol, haloperidol, spiroperidol, and pipamperone is described. These ^{18}F-labeled neuroleptic drugs are synthesized by a multistep synthesis in an overall radiochemical yield of 10-20% at end of bombardment (EOB) in a synthesis time of 90 min from EOB. The sequence involves the synthesis of NCA p-[^{18}F]fluorobenzonitrile from NCA [^{18}F]-fluoride and p-nitrobenzonitrile using the nucleophilic aromatic substitution reaction (^{18}F for NO_2). p-[^{18}F]Flurorbenzonitrile is rapidly converted to γ-chloro-p-[^{18}F]fluorobutyrophenone which is alkylated with appropriate amines to give NCA ^{18}F-labeled benperidol, haloperidol, spiroperidol, and pipamperone. The final product is purified by preparative high performance liquid chromatography (HPLC). The specific activities of the resulting butyrophenone neutroleptics were determined to be 3 Ci/μmol (at EOB) as determined by radioreceptor assay and HPLC assay.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 24295

24190 **(CONF-850578—1) High temperature reaction kinetics.** Jonah, C.D.; Beno, M.F.; Mulac, W.A.; Bartels, D. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009716.

From DOE/BES contractors' combustion meeting; Lake Geneva, WI, USA (22 May 1985).

During the last year the dependence of the apparent rate of OD + CO on water pressure was measured at 305, 570, 865 and 1223 K. An explanation was found and tested for the H_2O dependence of the apparent rate of OH(OD) + CO at high temperatures. The isotope effect for OH(D) with CO was determined over the temperature range 330 K to 1225 K. The reason for the water dependence of the rate of OH(OD) + CO near room temperatures has been investigated but no clear explanation has been found. 1 figure.

24191 **(DOE/ER/13282—T1) Aromatics oxidation and soot formation in flames. Technical progress report, August 15, 1984-August 14, 1985.** Howard, J.B.; McKinnon, J.T. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 1985. Contract FG02-84ER13282. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010154.

This research is concerned with the kinetics and mechanisms of aromatics oxidation and soot formation in flames. The scope includes measurement of profiles of soot-particle number concentration and size distribution and stable and radical gas species concentrations through the reaction zone of low-pressure flat premixed flames. The techniques for the soot-particle measurements are optical scattering and extinction in the flame and electron microscope analysis of particles collected with a molecular-beam sampling instrument. The techniques for gas-phase species are molecular-beam sampling with on-line mass spectrometry (MB/MS) supplemented by GC and GC/MS analysis of microprobe samples, and optical absorption from a water discharge lamp for OH radical concentration. Flame temperatures will be measured with thermocouples and Kurlbaum optical methods. Net reaction rates calculated from these

measurements will be used in screening tests of reaction mechanisms. The gas species profiles will be used to test and to extend existing flame chemistry models.

24192 **(DOE/PC/40283—T2) Comprehensive chemical kinetic reaction mechanism for the oxidation of n-butane.** Pitz, W.J.; Westbrook, C.K.; Proscia, W.M.; Dryer, F.L. (Lawrence Livermore National Lab., CA (USA); Princeton Univ., NJ (USA)). 1984. Contract W-7405-ENG-48;FG22-81PC40283. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010157.

A detailed chemical kinetic reaction mechanism is developed for the intermediate and high temperature oxidation of n-butane. The mechanism, consisting of 238 elementary reactions among 47 chemical species, is validated by comparison between computed and experimental results from shock tubes, turbulent flow reactor, and premixed laminar flames. The turbulent flow reactor experiments are described briefly. The model accurately reproduces n-butane combustion kinetics for wide ranges of pressure, temperature, and fuel-air equivalence ratio. In spite of the large number of species and reactions, it is found that computed results are most sensitive to reactions involving the H_2-O_2-CO submechanism, in agreement with other modeling studies of hydrocarbon oxidation. 38 references, 1 figure, 1 table.

24193 **Two-step saturated fluorescence detection of atomic hydrogen in flames.** Goldsmith, J.E.M. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Optics Letters;* **10**: No. 3, 116-118(Mar 1985).

We report a new variation on fluorescence detection, two-step saturated fluorescence spectroscopy, which can provide significant advantages over existing methods for detecting some atomic and molecular species. The method uses multiple-photon excitation of the selected atom or molecular, followed by saturated excitation of an optical transition from the initially excited state and subsequent detection of fluorescence emitted from the final state populated by the saturated excitation. The technique is demonstrated with the detection of atomic hydrogen in flames.

24194 **Preparation of furanoradialene by the flash vacuum pyrolysis of diesters of 3,4-bis(hydroxymethyl)-2,5-dimethylfuran.** Trahanovsky, W.S.; Cassady, T.J. (Iowa State Univ., Ames). *Journal of the American Chemical Society;* **106**: No. 26, 8197-8201(26 Dec 1984). Contract W-7405-ENG-82.

Pyrolysis of 3,4-bis(acetoxymethyl)-2,5-dimethylfuran (8) gives a 12% yield of a [4 + 2] dimer (10) of furanoradialene (4). A similar pyrolysis of 3,4-bis(benzoyloxymethyl)-2,5-dimethylfuran (9) gives 10 in 69% yield. Low-temperature ^1H and ^{13}C NMR spectral studies show that 4 is the primary pyrolysis product from 8 and 9, which forms 10 upon warming. Pyrolysis of 3,4-bis[acetoxydideuteriomethyl]-2,5-dimethylfuran (8-d_4) gives [4 + 2] dimer 10-d_8 via the intermediacy of 4-d_4. A concerted mechanism is proposed for the conversion of furanoradialene (4) to 10. 66 references.

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4201 General Engineering

24195 **(NP—5770233) Measurement and evaluation of torsional oscillation loads on shafts.** Sobota, J. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Messtechnik). 10 Jan 1983. 30p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85770233.

Suitable methods for measuring torsional oscillation loads on shafts are examined within the framework of this research project. In practice, it is difficult to perform direct measurement of the torque in the drive shaft. That is why bench-scale testing is carried out on an executed drive to answer the question of to what extent rotational vibration measurement at shaft end instead of torque measurement is suited for an assessment of torsional stresses and strains. Knowledge of torsional loads occurring during operation is particularly needed with drives featuring asynchronous motors owing to their high frequency of start-up operations. Reliable prediction of occurring moments is rendered particularly difficult when torsionally elastic couplings are used. For this reason, studies are focussed on these drive types.

24196 **(CE-Trans—7900) Monitoring of turbo-machines by shaft vibration measurement.** Thomas, H.J. Translated from *VGB Kraftwerkstechnik ;* **61**: No. 9, 725-730(Sep 1981). 17p. NTIS (US Sales Only), PC A02. File Number DE85901145. DE85901145

After a brief review of the history and practice of vibration monitoring, a simple examination of a single mass rotor is done treating the shaft, with two bearings, as a Laval shaft and using the method of the coefficients of influence and generally neglecting damping. The treatment is then expanded to cover an arrangement of a shaft supported at three points with two masses. Random imbalance vectors are taken into account. (LEW)

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 23499, 23531, 23545, 23784, 24566, 24941, 25068

24197 **(DOE/R3/08105—T1) Development of a tractor-drawn implement for digging and forming raised beds. Final technical report.** Meyer, E.W. (Meyer (Edwin W.), Alderson, WV (USA)). 1982. Contract FG43-81R308105. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009378.

The purpose of this grant was to build, test, and develop a tractor-drawn and -powered machine capable of tilling the land and forming raised beds suitable for the French intensive method of growing crops. By starting with a reliable used tractor-drawn tiller and adding off-the-shelf and custom-made components, a machine was developed that satisfactorily meets the proposed objectives.

24198 **(DPSPU—83-124-3) Safety analysis report: packages. DOT specification 7A - Type A container Mark 15 sludge shipping package.** Zeh, C.W. (comp.). (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Mar 1985. Contract AC09-76SR00001. 49p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010222.

Sludge or filter cake containing 1.1 wt % ^{235}U enriched uranium from Mark 15 fabrication will be packaged in 55-gallon containers and shipped from SRP to NLO, Fernald, Ohio for recovery of product. About 7 Metric Tons (MT) of filter cake will be produced from fabricating Mark 15 slugs each reactor charge. Packaged shipments of this material, consigned as exclusive use, will be shipped to NLO in Department of Transportation (DOT) Specification 7A - Type A packages under a DOE Certificate of Compliance for Fissile Class III shipments. "Type A packaging" is designed to retain containment and shielding integrity under normal conditions of transport. This report documents compliance of the package design, construction methods, material and test performance with DOT Specification 7A. This DOT 7A Type A package contains a carbon steel outer container which is a 0.060-in.-thick 55-gal, galvanized drum equipped with a gasketed closure. The outer container encloses a 0.090-in.-thick, open head, polyethylene liner with lid.

24199 **(EUR—8691-EN) Operation of gas turbines on liquid hydrogen.** Hewitt, F.A. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 85p. Commission of the European Communities, Luxembourg.

Rolls-Royce have wide experience in the application of gas turbine engine units to motive and stationary power production, using a wide range of fuels from diesel oil and kerosene to high and low combustion energy gases, but no specific previous experience in liquid hydrogen as a gas-turbine fuel. A detailed literature survey was therefore undertaken, the findings of which are reported in the first part of this work. A brief analysis was then undertaken of the performance of several liquid hydrogen fuelled engine cycles, based on current Rolls-Royce engines. An outline of the project work required was then drawn up, based on the project requirements, and the conclusions drawn from the literature survey and the engine

cycle analysis, and is presented in the next section as an introduction to the structure of the remainder of the report. The main technical effort was directed to four project areas: - (I) combustion chamber and burner design for use with hydrogen, (II) development and use of a precise, complex engine cycle modelling computer program to assess the performance of candidate system designs, (III) analysis of the use of fuel-cooled turbine cooling air in turbine hot parts, (IV) Heat exchanger and control system design for the conditioning of fuel prior to combustion. Finally, the results of all these studies were brought together to produce optimised hydrogen fuelled arrangements based on the RB 211-524 aero engine and the RB 211-24 Industrial power unit. The requirements for overall control system design and operation were then considered, and the project terminated with an assessment of alternative heat-exchange based engines making use of the clean characteristics of the hydrogen exhaust products. Conclusions were then drawn up which incorporated some recommendations for experimental work.

24200 **(NE-F—3-42-Rev.3-84) Operating policy of DOE filter test program. Revision 3-84.** (Oak Ridge National Lab., TN (USA)). 29 Mar 1985. Contract AC05-84OR21400. 9p. Nuclear Standards Management Center, P.O. Box Y, Oak Ridge, TN 37831. File Number TI85009459.

This standard establishes policies and procedures for the operation of US Department of Energy (DOE) Filter Test Facilities (FTF) at Oak Ridge, Tennessee; Golden, Colorado; and Richland, Washington. This standard also establishes DOE-wide HEPA filter procurement, HEPA filter testing, and to the degree stated respirator canister testing policies.

24201 **(NE-F—3-43-Amend.3-85) Quality assurance testing of HEPA filters and respirator canisters. Amendment 3-85.** (Oak Ridge National Lab., TN (USA)). 15 Mar 1985. Contract AC05-84OR21400. 8p. Nuclear Standard Management Center, P.O. Box Y, Oak Ridge, TN 37831. File Number TI85009460.

This standard covers requirements for the quality assurance inspection and testing of HEPA filters and respirator canisters by the US Department of Energy (DOE) Filter Test Facilities (FTFs) at Oak Ridge, Tennessee; Golden, Colorado; and Richland, Washington. The standard implements the policies established in NE F 3-42, Operating Policy of DOE Filter Test Programs, and provides a basis for the preparation of written procedures for conducting primary FTF functions. As noted in NE F 3-42, Sec. 4, these standards apply only to filters used at DOE installations for environmental protection purposes. These filters are described as Type B filters in Institute of Environmental Sciences HEPA Filter Practices, IES Designation RP-CC-001.

24202 **(NLR-MP—84001-U) Engineering significance of fatigue thresholds and short fatigue cracks for structural design.** Wanhill, R.J.H. (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam (Netherlands)). Jan 1984. 12p. Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands.

The significances of fatigue thresholds and short fatigue cracks for engineering structures are examined in a general way with respect to design philosophy (safety and durability), the anticipated service loads and non-destructive inspection (NDI). Examples are given for spacecraft payloads, aircraft structures (including landing gear and jet engines), offshore and littoral structures, thick-walled pressure vessels, wind turbines, power generating equipment and ship propellers. (J.C.R.)

24203 **(NUREG/CR—4111) Comparative study of HEPA filter efficiencies when challenged with thermal- and air-jet-generated di-2-ethylhexyl sebecate, di-2-ethylhexyl phthalate, and sodium chloride.** Kerschner, H.F. III; Ettinger, H.J.; DeField, J.D.; Beckman, R. (Los Alamos National Lab., NM (USA)). Dec 1984. Contract W-7405-ENG-36. 70p. (LA—9985-MS). NTIS, PC A04/MF A01 - GPO. File Number TI85010353.

Respirators fitted with high-efficiency particulate (HEPA) cartridge filters are designed to remove dust, fumes, mists, and airborne particulate radionuclides. If these filters are to be reused, a Quality Assurance (QA) program must be established to ensure that filter efficiency remains greater than 99.97%. The standard method for performing QA testing is to challenge the filter with a thermally generated aerosol of 0.3-μm-diam di-2-ethylhexyl phthalate (DEHP). Because of potential toxicological and other problems associated with the use of monodisperse DEHP, an investigation to study measured filter efficiencies on a HEPA respirator filter population, using several recommended replacement aerosols, has been conducted. Aerosols compared in this study were thermally generated di-2-ethylhexyl sebecate (DEHS), thermally generated DEHP, air-jet-generated DEHS, and air-jet-generated salt (NaCl). The study also focused on determining compatibility for parallel use of aerosols generated for respirator-fit testing for use in QA filter testing. Results indicate that a polydisperse air-jet-generated aerosol of DEHS can substitute for thermally generated DEHP as a method of providing QA testing of HEPA respirator filters and that equipment used in the study designed for respirator quantitative-fit testing can easily be modified to perform this function. 30 refs., 28 figs., 11 tabs.

24204 **(UCID—20389) Failure analysis of fractured capscrews in centrifugal coolant compressor.** Witherell, C.E. (Lawrence Livermore National Lab., CA (USA)). 25 Mar 1985. Contract W-7405-ENG-48. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010029.

This study was made to determine the cause of failure of capscrews that retain a baffle plate in a Freon 11 centrifugal compressor manufactured by the Trane Company. The affected unit is installed in Building 490 at LLNL. The capscrews failed through hydrogen embrittlement. The source for hydrogen appears to have been corrosion. In a dissimilar metal couple of aluminum and uncoated high strength, highly-stressed steel, corrosive environments would generate hydrogen at the the steel side of the couple and embrittle it. There is no evidence that the manufacturer took precautions to prevent such an occurrence.

24205 **(UCID—20394) Operation of HFTF to test the MIT 12 T coil.** Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 28 Mar 1985. Contract W-7405-ENG-48. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010409.

The MIT coil tested in HFTF to a peak field of very nearly 12 T. The accomplishment is noteworthy as a demonstration of "reactor relevant" superconductors to high field in a realistic coil environment. Just the operation of the High Field Test Facility (HFTF) in providing the necessary test conditions is also no trivial feat. This note reports the work involved in testing the MIT 12T coil, with emphasis given to the test facility itself. Data specific to the MIT coil are relegated to appendices.

24206 **(UCRL—91609) Automatic volume calibration system.** Gates, A.J.; Aaron, C.C. (Lawrence Livermore National Lab., CA (USA)). 6 May 1985. Contract W-7405-ENG-48. 30p. (CONF-850582—7). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85008955.

From 31. ISA international instrumentation symposium; San Diego, CA, USA (6 May 1985).

The Automatic Volume Calibration System presently consists of three independent volume-measurement subsystems and can possibly be expanded to five subsystems. When completed, the system will manually or automatically perform the sequence of valve-control and data-acquisition operations required to measure given volumes. An LSI-11 minicomputer controls the vacuum and pressure sources and controls solenoid control valves to open and close various volumes. The input data are obtained from numerous displacement, temperature, and pressure sensors read by the LSI-11. The LSI-11 calculates the unknown volume from the data acquired during the sequence of valve operations. The results, based on the Ideal Gas Law, also provide information for feedback and control. This paper describes the volume calibration system, its subsystems, and the integration of the various instrumentation used in the system's design and development. 11 refs., 13 figs., 4 tabs.

24207 **(NE-F—3-45T-Rev.3-85) Specifications for HEPA filters used by DOE contractors.** (Oak Ridge National Lab., TN (USA)). 22 Mar 1985. Contract AC05-84OR21400. 19p. Nuclear Standards Management Center, P.O. Box Y, Oak Ridge, TN 37831. File Number TI85009461.

This standard establishes minimum specification requirements for high efficiency particulate air (HEPA) filters to be used in DOE environmental protection applications. The standard specifies the minimum requirements to be included in contractor specifications.

24208 **Design of resilient processing plants. VI. The effect of right-half-plane zeros on dynamic resilience.** Holt, B.R.; Morari, M. (Univ. of Wisconsin, Madison). *Chemical Engineering Science;* **40**: No. 1, 59-74(1985). Contract AC02-80ER10645.

The quality of control achievable on a given system, its dynamic resilience, represents a new and important concept in control. The concept of dynamic resilience is extended to right-half-plane-transmission zeroes. In particular it provides quantitative measures of how the location of the zero affects the achievable performance for both single and multiple input systems. For multiple input systems it is demonstrated how the impact of the zero can be isolated to a single output. It is also shown how the presence or absence of these zeros influence the choice of decoupled as opposed to interactive control.

24209 **Liquid blocking check valve.** Merrill, J. T. (to The United States of America as represented by the United States Department of Energy). US Patent 4,489,744. 25 Dec 1984. Filed date 27 Sep 1982. vp.

PAT-APPL-425142.

A liquid blocking check valve useful particularly in a pneumatic system utilizing a pressurized liquid fill chamber. The valve includes a floatable ball disposed within a housing defining a chamber. The housing is provided with an inlet aperture disposed in the top of said chamber, and an outlet aperture disposed in the bottom of said chamber in an offset relation to said inlet aperture and in communication with a cutaway side wall section of said housing.

24210 **Bag-out material handling system.** Brak, S. B.; Milek, H. F. (to The United States of America as represented by the United States Department of Energy). US Patent 4,489,538. 25 Dec 1984. Filed date 26 Feb 1982. vp.

PAT-APPL-352743.

A bagging device for transferring material from a first chamber through an opening in a wall to a second chamber includes an outer housing communicating with the opening and having proximal and distal ends relative to the wall. An inner housing having proximal and distal ends corresponding to those of the outer housing is mounted in a concentrically spaced, sealed manner with respect to the distal end of the outer housing. The inner and outer housings and mounting means therebetween define an annular chamber, closed at its distal end and open at its proximal end, in which a pliable tube is slidably positioned in sealed engagement with the housings. The pliable tube includes a sealed end positioned adjacent the proximal end of the inner housing so as to maintain isolation between the first and second chambers. Displacement of the material to be bagged from the first chamber along the inner housing so as to contact the sealed portion of the pliable bag allows the material to be positioned within the pliable bag in the second chamber. The bag is then sealed and severed between where the material is positioned therein and the wall in providing a sealed container for handling the material. The pliable tube when substantially depleted slides onto a narrow portion of the inner housing to allow a new pliable tube to be positioned over the old pliable tube. Remnants of the old pliable tube are then discharged into the new pliable tube with the bagging and removal of additional material.

24211 **A-15 superconducting composite wires and a method for making.** Suenaga, M.; Klamut, C. J.; Luhman, Th. S. (to The United States of America as represented by the United States Department of Energy). US Patent 4,489,219. 18 Dec 1984. Filed date 8 Jun 1983. vp.

PAT-APPL-500806.

A method for fabricating superconducting wires wherein a billet of copper containing filaments of niobium or vanadium is rolled to form a strip which is wrapped about a tin-alloy core to form a composite. The alloy is a tin-copper alloy for niobium filaments and a gallium-copper alloy for vanadium filaments. The composite is then drawn down to a desired wire size and heat treated. During the heat treatment process, The tin in the bronze reacts with the niobium to form the superconductor niobium tin. In the case where vanadium is used, the gallium in the gallium bronze reacts with the vanadium to form the superconductor vanadium gallium. This new process eliminates the costly annealing steps, external tin plating and drilling of bronze ingots required in a number of prior art processes.

24212 **Fully synthetic taped insulation cables.** Forsyth, E. B.; Muller, A. C. (to The United States of America as represented by the United States Department of Energy). US Patent 4,487,991. 11 Dec 1984. Filed date 15 Jul 1983. vp.

PAT-APPL-514127.

A high voltage oil-impregnated electrical cable with fully polymer taped insulation operable to 765 kV. Biaxially oriented, specially processed, polyethylene, polybutene or polypropylene tape with an embossed pattern is wound in multiple layers over a conductive core with a permeable screen around the insulation. Conventional oil which closely matches the dielectric constant of the tape is used, and the cable can be impregnated after field installation because of its excellent impregnation characteristics.

24213 **Drum tie-down apparatus.** Morse, H. E. (to The United States of America as represented by the United States Department of Energy). US Patent 4,487,537. 11 Dec 1984. Filed date 1 Feb 1983. vp.

PAT-APPL-462817.

A drum tie-down apparatus for securing drum-like containers in an upright position to a floor or platform of a transportation vehicle having spaced apart cargo tie-down points. The apparatus comprises a pair of cylindrical, hollow tube segments horizontally oriented and engageable with a drum lid adjacent opposite rim edges, flexible strap segments for connecting upper and lower central portions of the tube segments together across the drum lid and a pair of elongated flexible tie-down segments, one extending horizontally through each of the tube segments, the ends thereof being attached to said spaced apart tie-down points such that end portions of the pair of tie-down segments extend downwardly and radially outwardly from the tube segments to the tie-down points.

24214 **Field and temperature dependent quantum phenomena in SNS junctions.** Miller, S.L. Ames, IA; Iowa State Univ. (1984). 111p. University Microfilms Order No. 84-23,657.Contract W-7405-ENG-82.

Thesis (Ph. D.).

The critical current of cross type superconductor-normal metal-superconductor (SNS) junctions were studied as a function of temperature, applied magnetic field, and junction geometry in order to understand the physical processes occurring in SNS Josephson junction devices. In the absence of an applied field, the critical current is found to follow the theory of de Gennes in the regime near the critical temperature where the theory applies. In small fields, Fraunhofer patterns of remarkable quality are obtained in the regime where self field effects are negligible. From the temperature dependence of the period of oscillation of these Fraunhofer patterns, the field penetration depth $\lambda(T)$ of the superconducting banks is inferred and the penetration depth is found to have the same functional temperature dependence as that predicted by the BCS theory. The resulting critical current surface, functions of temperature and applied parallel magnetic field, shows that quantum oscillations can be driven by temperature, in good agreement with theory. If the field is applied perpendicular to the plane of the junction the critical current is found to decrease monotonically with increasing fields, going as 1/H for large fields. The effects of individual misaligned trapped vortex pairs in the superconducting electrodes on the maximum Josephson current is examined. The critical current is found to decrease in discrete steps as more vortices are introduced into the junction. The critical current vs. field curves for junctions containing trapped vortices are found to agree qualitatively with theory.

24215 Design, fabrication, and metrology of negative branch waxicons. Guha, J.K.; Yoder, R. (Rockwell International Corp., Canoga Park, CA). *Optical Engineering;* **21**: No. 6, 963-967(Nov-Dec 1982).

Three negative branch waxicons, all with magnifications of 1.875, were fabricated by diamond turning at the Oak Ridge Y-12 Plant. One of the waxicons was a simple beam compactor, and the other two had varying degrees of ray redistribution designed into the surface profiles. Interferometric data taken during the fabrication process were used to make tool offset position corrections between successive cuts. The final surface was tested by single and double-pass interferometry. The intensity redistribution effect was measured by using a collimated beam incident on the annular leg and scanning the intensity of the compacted beam. All three waxicons were intended for use in a HSURIA (half-symmetric unstable resonator with internal axicon) configuration.

24216 Finite difference calculation of current distributions at polarized electrodes. Prentice, G.A.; Tobias, C.W. (Lawrence Berkeley Lab., CA). *AIChE (American Institute of Chemical Engineers) Journal;* **28**: No. 3, 486-492(May 1982). Contract W-7405-ENG-48.

The changing geometry of electrodes undergoing electrodeposition or dissolution can be simulated by successive solutions of Laplace's equation with nonlinear boundary conditions. To overcome the instability in the finite-difference calculation caused by nonlinear boundary conditions, a weighting algorithm to compute the new surface potential on successive iterations has been developed.

4203 Lasers

REFER ALSO TO CITATION(S) 24215, 24252, 25042, 25043

24217 (BNL—36080) Summary of the working group on FEL theory. Pellegrini, C. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 8p. (CONF-8409163—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009769.

From Workshop on coherent and collective propagation of relativistic E-beams and electromagnetic radiation; Villa Olmo, Como, Italy (13 Sep 1984).

The working group on FEL theory dedicated most of its discussions to topics relevant to the high gain regime in a free electron laser. In addition the area of interest was mainly restricted to FELs for the production of XUV radiation (<1000 A). A list of the topics that were felt to be relevant is: (1) characterization of the FEL high gain regime; (2) the amplified spontaneous emission mode of operation (ASE); (3) superradiance in FELs; (4) diffraction effects for high gain FELs; (5) noise and start-up; (6) coherence properties of the radiation for the ASE and superradiant FELS. 9 references.

24218 (LA-UR—82-2268) Excimer laser chemical problems. Tennant, R.; Peterson, N. (Los Alamos National Lab., NM (USA)). 1982. Contract W-7405-ENG-36. 82p. NTIS, PC A05. File Number DE85011051.

Techniques need to be developed to maintain XeF and XeCl laser performance over long periods of time without degradation resulting from chemical processes occurring within the laser. The dominant chemical issues include optical damage, corrosions of laser materials, gas contamination, and control of halogen concentration. Each of these issues are discussed and summarized. The methods of minimizing or controlling the chemical processes involved are presented.

24219 (LA-UR—85-883) High-brightness photoemitter development for electron accelerator injectors. Fraser, J.S.; Sheffield, R.L.; Gray, E.R. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850128—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009548.

From 2. international workshop on laser acceleration of particles; Los Angeles, CA, USA (7 Jan 1985).

Free-electron-laser (FEL) oscillators require a train of high-brightness bunches. Conventional subharmonic bunchers are currently used with rf linacs to generate pulse trains, but the resulting dilution of the transverse phase space and lower beam brightness are unacceptable for high-performance FELs. Recent developments suggest that photoemitters of high quantum efficiency combined with rapid acceleration can produce pulse trains of higher brightness than has been achieved before.

24220 (N—85-13221) Investigation of RF excited CW CO_2 waveguide lasers. Hochuli, U. (Maryland Univ., College Park (USA)). Nov 1984. 26p. (NASA-CR—174106). NTIS, PC A03/MF A01.

The RF excited 2 to 3W CW CO2 waveguide lasers with lifetimes of the order of 10(4) to 2.10(4) hours were produced. This was achieved with CO and N2 bearing gas mixtures and with internal as well as external discharge electrodes. It is noted that these tests were conducted with unstabilized lasers which drift around in their signatures. The average power output was reduced to about one half of the highest peak power output in the signature. One of the lasers, no. 1.1, still shows 60% of its original output power after it was cycled on and off every 10 minutes for more than 50,000 times. The starting voltage and driving point impedance of the RF excited gas discharge structure for different gas pressures and mixtures were measured. These data will serve as a basis for the matching and starting network optimization. The second laser body was frit and indium sealed. To our a vacuum leak between the bore and electrode holes was noted. The leak seems to be due to a defect or crack in the BeO body.

24221 (N—85-13224) Computation of the nonequilibrium flow in a gas dynamic laser. Yen, H.H.; Chen, L.Y. (Air Force Systems Command, Wright-Patterson AFB, OH (USA)). Apr 1984. 29p. (AD-A—141022; FTD-ID(RS)T—0311-84). NTIS, PC A03/MF A01.

A three-modes-four temperatures vibrational relaxation model for a CO2-N2-H2O laser system is presented, and a set of fairly rigorous relaxation equations given. A series of problems related to computations of pseudo-one-dimensional nonequilibrium flows was analyzed and massive numerical computations using data obtained, were carried out for the rate of relaxation.

24222 (SAND—84-2016C) Four-photon resonant third harmonic generation. Smith, A.V. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 5p. (CONF-850345—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010070.

From Southwest conference on optics; Albuquerque, NM, USA (4 Mar 1985).

The phenomenon of resonant enhancement of optical third harmonic generation near four-photon resonances is studied with the goal of understanding the nonlinear processes involved and evaluating them as a means of more efficiently generating coherent vacuum ultraviolet light. 4 refs., 4 figs.

24223 (UCRL—92336) Review of short wavelength lasers. Hagelstein, P.L. (Lawrence Livermore National Lab., CA (USA)). 18 Mar 1985. Contract W-7405-ENG-48. 34p. (CONF-840786—5). NTIS, PC A03/MF A01; GPO Dep. File Number DE85009858.

From 9. international conference on atomic physics; Seattle, WA, USA (23 Jul 1984).

There has recently been a substantial amount of research devoted to the development of short wavelength amplifiers and lasers. A number of experimental results have been published wherein the observation of significant gain has been claimed on transitions in the EUV and soft x-ray regimes. The present review is intended to discuss the main approaches to the creation of population inversions and laser media in the short wavelength regime, and hopefully aid workers in the field by helping to provide access to a growing literature. The approaches to pumping EUV and soft x-ray lasers are discussed according to inversion mechanism. The approaches may be divided into roughly seven categories, including collisional excitation pumping, recombination pumping, direct photoionization and photoexcitation pumping, metastable state storage plus optical pumping, charge exchange pumping, and finally, the extension of

free electron laser techniques into the EUV and soft x-ray regimes. 250 references.

24224 Observation of stimulated emission in the 119 to 149 nm range from HD excited by picosecond 193 nm radiation. Luk, T.S.; Egger, H.; Mueller, W.; Pummer, H.; Rhodes, C.K. (Department of Physics, University of Illinois at Chicago, Chicago, Illinois 60680). *Journal of Chemical Physics;* **82**: No. 10, 4479-4482(15 May 1985).

Intense stimulated emission in the 119 to 149 nm region is observed from HD excited by two quanta at 193 nm. For certain transitions, the conversion efficiency approaches 1% so that peak powers of ~10 MW are produced. Electron collisions with the HD (E,F) level are found to efficiently transfer population to the HD(C) state which produces stimulated emission on several $C \rightarrow X$ Werner band lines in the vicinity of 120 nm. The data on the pressure dependence of the stimulated signals strongly support the conclusion that, in comparison to H_2, HD exhibits a large isotopic dependence on the cross section for rotationally inelastic electron collisions in electronically excited states. The rate constant for this rotationally inelastic process is estimated as $\sim 2 \times 10^{-7}$ cm^3/s. This is the first observation of an isotopically sensitive electron collisional process involving an electronically excited level.

24225 Generation of high-intensity coherent raditon in the soft-x-ray and vacuum-ultraviolet region. Murphy, J.B.; Pellegrini, C. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of the Optical Society of America B: Optical Physics;* **2**: No. 1, 259-264(Jan 1985). Contract AC02-76CH00016.

An electron beam can be made to interact with an undulator magnet so that a collective unstable mode is excited. In this mode, the beam generates coherent radiation whose wavelength is detemined by the undulator period and the electron energy. By proper choice of the electron-beam energy, energy dispersion, and density, one can obtain coherent radiation in the soft-x-ray region with peak and average power of the order of hundreds of megawatts and hundreds of milliwatts, respectively. Larger peak powers, of the order of a gigawatt, can be expected for UV radiation with λ in the range of 500—2000 A. We discuss the physical principles of these systems and give examples of how they might be built.

24226 Evolution of long pulses in a tapered wiggler free-electron laser. Goldstein, J.C. (Los Alamos National Lab., NM). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **453**: 1-10(1984).

The evolution of a long pulse (pulse length much greater than the slippage distance) in a tapered wiggler free-electron laser was studied by numerical solution of the 1-D theoretical model for a realistic set of magnet, electron beam, and optical resonator parameter values. Single-pass gain curves were calculated for low and high light intensity. It was found that an initial, low-amplitude, incoherent pulse grows into a coherent pulse whose growth rate agrees with the calculated small signal gain. The transient evolution of coherent pulses was calculated for several different cavity length detunings, and a quasi steady-state desynchronism curve is given. The frequency changing behavior of the optical pulse is shown to occur through sideband generation associated with synchrotron oscillations. Pulse evolution with an ideal intracavity high-pass optical filter is calculated.

24227 InP:Fe picosecond photoconductors. Hammond, R.B.; Wagner, R.S.; Paulter, N.G. (Los Alamos National Lab., NM). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **439**: 192-196(1983).

The impulse response of InP:Fe photoconductors to mode-locked dye laser excitation was measured. Bias, excitation, and Fe concentration dependence of the impulse response are reported. Linearity of response over two decades in both bias and excitation and independence of transient-response pulse width to both bias and excitation are demonstrated. Correlation was observed between Fe concentration and transient response pulse width. Finally, optical electronic autocorrelation of impulse response consistent with the sampling oscilloscope measurements is reported.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 23772, 23773

24228 (CONF-850351—5) Assessment of a failure probability prediction technique for ceramic heat exchanger components. Smith, K.O.; Poeppel, R.B. (Solar Turbines, Inc., San Diego, CA (USA); Argonne National Lab., IL (USA)). Feb 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02. File Number DE85009737.

From 30. international gas turbine conference and exhibit; Houston, TX, USA (18 Mar 1985).

A study was conducted to establish analytical design techniques for predicting the failure probability of ceramic heat exchanger components. Three test specimen geometries representing subscale components of an axial flow, tubular ceramic heat exchanger were selected for evaluation. Failure probability predictions for the specimens subjected to mechanical loads were made using finite element stress and two-parameter Weibull analyses. Weibull parameters for sintered alpha-SiC were determined using as-sintered flexure bars in four-point-bend strength tests. Assessments of the prediction accuracy were made by failure testing populations of the three specimen geometries fabricated using sintered alpha-SiC. Tests were conducted at ambient conditions and with a rapid loading rate. Experimental results indicate that reasonably accurate failure probability predictions can be made. 3 refs., 11 figs.

24229 (NUREG/CR—3193) Forced convective, nonequilibrium, post-CHF heat transfer experimental data and correlation comparison report. Gottula, R.C.; Condie, K.G.; Sundaram, R.K.; Neti, S.; Chen, J.C.; Nelson, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1985. Contract AC07-76ID01570. 551p. (EGG—2245). NTIS, PC E16/MF A01 - GPO. File Number TI85009331.

Includes 2 sheets of 24x reduction microfiche.

Forced convective, postcritical-heat-flux heat transfer experiments with water flowing upward in a vertical tube have been conducted at the Idaho National Engineering Laboratory. Thermodynamic nonequilibrium in the form of superheated vapor temperatures was measured at a maximum of three different axial levels. Steady-state experiments were conduced at pressures of 0.2 to 0.7 MPa, mass fluxes of 12 to 24 kg/m^2 x s, heat fluxes of 7.7. to 27.5 kW/m^2, and test section inlet qualities of 38 to 64%. Quasi-steady-state (slow moving quench front) experiments were conducted at pressures of 0.4 to 7 MPa, mass fluxes of 12 to 70 kg/m^2 x s, heat fluxes of 8 to 225 kW/m^2, and test section inlet qualities of -7 to 47%. The multiple probe data and the data taken above 0.4 MPa are new data in parameter ranges not previously obtained. Comparison of the data with current vapor generation models and wall heat transfer models yielded unsatisfactory results. This is attributed to the effects of nonequilibrium, quench front quality, and distance from the quench front, which are factors not included in the current models compared.

24230 Porous-media formulation for multiphase flow with heat transfer. Sha, W.T. (Argonne National Lab., IL (USA)); Chao, B.T.; Soo, S.L. (Illinois Univ., Champaign (USA)). *Nuclear Engineering and Design;* **82**: No. 2/3, 93-106(Oct 1984).

A set of governing differential-integral conservation equations for a multiphase system with stationary structures is presented. This set of governing equations is derived based on the porous media formulation via local volume averaging, and is particularly suitable for numerical computations in most engineering problems. The integrals depend on interface configurations and are probabilistic in nature. These equations are reducible to differential equations under simplifying assumptions for a specific configuration of the interface. The porous-media formulation presented here uses concepts of volume porosity, directional surface permeabilities, distributed resistance, and distributed heat source and sink. The concept of directional surface permeability is new and greatly facilitates modeling in temperature and velocity fields in anisotropic media, and, in general, improves resolution and accuracy, particularly for momentum transfer. Both the conventional porous-media formula-

tion and the continuum formulation are subsets of the new porous media formulation.

24231 **Two-fluid model and hydrodynamic constitutive relations.** Ishii, M. (Argonne National Lab., IL (USA). Reactor Analysis and Safety Div.); Mishima, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). *Nuclear Engineering and Design;* **82**: No. 2/3, 107-126(Oct 1984).

Two-fluid formulation for two-phase flow analyses is presented. A fully three-dimensional model is obtained from the time averaging, whereas the one-dimensional model is developed from the area averaging. The constitutive equations for the interfacial terms are the weakest link in a two-fluid model because of considerable difficulties in terms of experimentation and modeling. However, these are of supreme importance in determining phase interactions. In view of this, the interfacial transfer terms have been studied in great detail both for the three- and one-dimensional models. New interfacial area, drag, virtual mass, droplet size and entrainment correlations are presented. In the one-dimensional model, a number of serious shortcomings of the conventional model have been pointed out and new formulations to eliminate them are presented. These shortcomings mainly arose due to the improper consideration of phase distributions in the transverse direction.

24232 **Two-phase thermal-hydraulic simulations with COMMIX-2.** Miao, C.C.; Baumann, W.L.; Domanus, H.M.; Shah, V.L.; Sha, W.T. (Argonne National Lab., IL (USA). Components Technology Div.). *Nuclear Engineering and Design;* **82**: No. 2/3, 205-214(Oct 1984).

The COMMIX-2 computer code has been developed for steady/unsteady, three-dimensional thermal-hydraulic analysis of reactor components under normal and off-normal operating conditions. To permit analysis of a wide spectrum of flow conditions, i.e., from homogeneous and equilibrium to nonhomogeneous and nonequilibrium conditions, we have provided two alternative models. One is the two-fluid model, and the other is the homogeneous equilibrium model. The new concept of volume porosity, surface permeability, distributed resistance, and distributed heat source is implemented in the code to permit modeling of a flow domain with stationary solid objects. The present paper briefly describes the unique features of the COMMIX-2 computer code and presents the results of two two-phase numerical simulations with COMMIX-2. One simulation is the transient-boiling experiment in a seven-pin hexagonal fuel assembly. The other is boiling due to blockage in a square fuel assembly. The converged results of numerical simulation and comparison with measurement demonstrate the two phase simulation capability of the COMMIX-2 computer code.

4205 Materials Testing

REFER ALSO TO CITATION(S) 23789, 23790, 23991, 24028

24233 (DOE/ER—0046/18, pp 133-141) **Preparation of ion-irradiated foils for cross-section analysis.** Zinkle, S.J.; Sindelar, R.L. (Univ. of Wisconsin, Madison). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

A simple, routine method has been developed which allows ion-irradiated foils to be examined in cross-section. The method has been successfully demonstrated on three alloy systems: stainless steel, a low-chromium steel, and some high-strength copper alloys. The technique is generally applicable to practically all metals.

24234 **(INIS-mf—9499) Quality assurance services.** (UKAEA Springfields Nuclear Power Development Labs.). [1985]. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780862.

For over 20 years the quality assurance services at the Springfields Laboratories have been concerned with manufacturing both simple and complex engineering products to the highest standard. The scientists working there have considerable expertise in the practical application of quality control and the development and design of inspection and non-destructive testing equipment. The folder contains six sheets or leaflets illustrating the work and equipment. The subjects are the mechanical standards laboratory, nondestructive testing, the digitising table, the peripheral camera, automated measurement, data handling and presentation, and the computer controlled three axis co-ordinate measuring machine.

24235 **(SAND—84-1637) Ultrasonic test evaluation of the insert bond on hermetic connectors.** Walkington, P.D. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85008394.

Two ultrasonic test procedures were developed to evaluate the bond between the blue insert socket support and glass in hermetic connectors. A control group of cylindrical-hermetic SA connectors was assembled with known defects and processing anomalies and evaluated by two ultrasonic test methods and an insert pull test. Both ultrasonic test methods were able to identify a good/bad bond between the insert and glass; however, no correlation was found between the ultrasonic test results and the insert pull test results.

24236 **(UCRL—53613) Visual simulation of radiographs.** Laguna, G. (Lawrence Livermore National Lab., CA (USA)). 18 Jan 1985. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010213.

A method for computer simulation of radiographs has been added to the LLNL version of the solid modeler TIPS-1 (Technical Information Processing System-1). This new tool will enable an engineer to compare an actual radiograph of a solid to its computer-generated counterpart. The appearance of discrepancies between the two can be an indication of flaws in the solid object. Simulated radiographs can also be used to preview the placement of x-ray sources to focus on areas of concern before actual radiographs are made.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 24234

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 24124, 24566

24237 **Gas mixture for diffuse-discharge switch.** Chistophorou, L. G.; Carter, J. G.; Hunter, S. R. (to The United States of America as represented by the United States Department of Energy). US Patent 4,490,650. 25 Dec 1984. Filed date 31 Aug 1982. vp.

PAT-APPL-413588.

Gaseous medium in a diffuse-discharge switch of a high-energy pulse generator is formed of argon combined with a compound selected from the group consisting of CF_4, C_2F_6, C_3F_8, n-C_4F_{10}, WF_6, $(CF_3)_2S$ and $(CF_3)_2O$.

24238 **Solid-state circuit breaker with current limiting characteristic using a superconducting coil.** Boenig, H. J. (to The United States of America as represented by the United States Department of Energy). US Patent 4,490,769. 25 Dec 1984. Filed date 16 Aug 1982. vp.

PAT-APPL-408108.

A thyristor bridge interposes an ac source and a load. A series connected DC source and superconducting coil within the bridge biases the thyristors thereof so as to permit bidirectional ac current flow therethrough under normal operating conditions. Upon a fault condition a control circuit triggers the thyristors so as to reduce ac current flow therethrough to zero in less than two cycles and to open the bridge thereafter. Upon a temporary overload condition the control circuit triggers the thyristors so as to limit ac current flow therethrough to an acceptable level.

4210 Combustion Systems

24239 **(CONF-8310201—4) Impact of fuel composition on deposits and on high-temperature corrosion in industrial/commercial boilers and furnaces: a synthesis.** Bellan, J. Elghobashi, S. (Jet Propulsion Lab., Pasadena, CA (USA); California Univ., Irvine (USA)). 1983. Contract AI01-81CS66001. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010018.

From Combustion Institute fall meeting of the western states section; Los Angeles, CA, USA (17 Oct 1983).

Literature relevant to the problems of deposits and corrosion in industrial/commercial furnaces and boilers is analyzed, and the facts are synthesized into a picture that addresses corrosion problems expected with the use of unconventional fuels. Corrosion greatly depends on the phenomena occurring during the combustion of fuel-oil sprays introduced into the furnace. Corrosion by gases is found to be unimportant. Deposits are much more corrosive when in liquid form, although corrosion by solid deposits is by no means negligible. Recent advances in the theory of deposition from combustion gases are also outlined in this study. The literature survey shows that the main fuel constituents causing corrosion are sulfur, alkali metals, vanadium, carbon and carbon monoxide, iron, and chloride. Sometimes one of these compounds acts as a catalyst in corrosive reactions initiated by another compound. In some cases a corrosive compound will inhibit the corrosive action of another corrosive compound. Effects of additives and the furnace operating conditions are discussed, and potential problems with both additives and new operating conditions are mentioned. The recommendations at the end of this study present a comprehensive set of areas to be investigated. 42 reference, 15 figures, 12 tables.

24240 **(DOE/CE/40539—02) Development of a coal/water slurry-fueled diesel engine for industrial cogeneration. Task 1.0 topical report: thermodynamic analysis.** Nydick, S.; Wang, C.C. (Thermo Electron Corp., Waltham, MA (USA). Energy Systems Div.). May 1985. Contract AC02-82CE40539. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85010455.

This project is part of a program in which the objective is to establish a high efficiency prototype industrial power system that can burn coal directly. The power system consists of a slow-speed, two-stroke diesel engine and a fuel preparation system which provides clean micronized coal in a water slurry for uses as the primary fuel. This topical report is concerned with the subject of Task 1: Thermodynamic Analysis. Chapter 1 presents the results of a parametric study utilizing a macroscopic thermodynamic model of diesel engine performance for a coal slurry fuel and compares results of the analysis with experimental data for a diesel fuel-fired engine. Chapter 2 combines the results of the Thermodynamic Analysis and Slurry Evaluation (reported in the Task 2 Topical Report: Fuel Preparation, Beneficiation and Handling) to arrive at preliminary trade-offs for evaluating the type of slurries which should be used in the diesel engine tests scheduled to commence in October 1984 in a single-cylinder test facility located at the Sulzer Brothers Ltd. plant in Winterthur, Switzerland. Chapter 3 presents conclusions derived from both the thermodynamic and the trade-off analysis. Appendix A contains a description and listing of the computer codes utilized in this program.

24241 **(EUR—9404-DE) Experimental further development of the circulating fluidized-bed combustion process for steam boiler firing on the basis of low-grade fuels and coal.** Duerrfeld, H.; Failing, K.H. (Commission of the European Communities, Luxembourg. Directorate-General for Information, Market and Innovation). 1984. 77p. (In German). Commission of the European Communities, Luxembourg.

With a view to making use of a widely spread fuel range for energy-conserving and environmentally harmless steam generation, a circulating fluidized bed firing system developed by STEINMUeLLER for 1 MW thermal output has been installed. The enlargement of the cross section of the furnace in the lower part renders any fuel and additive conditioning unnecessary. All plant components have given proof of their functional capability. Widely differing coal grades could be burnt in this system with high efficiency and moderate pollutant emission. Within a period of 768 operating hours, the boiler load, primary/secondary air-ratio and calcium/sulphur ratio were experimentally varied. The results demonstrate that this advanced technology of circulating fluidized bed firing with integrated steam generation is economically attractive as well.

24242 **(IFRF-F—259/a/1) Studies on the near field aerodynamics of swirl burners; results of the NFA 1 investigation. Flow visualization and hot wire measurements in isothermal swirling flows.** Hagiwara, A.; Bortz, S. (International Flame Research Foundation, Ijmuiden (Netherlands)). Nov 1984. 216p. International Flame Research Foundation, Ijmuiden, Netherlands.

The first phase of the IFRF Near Field Aerodynamics project has led to a considerable amount of insight into the relationship between the flow field created by a swirling flow and the swirl level and the geometry of the confining surfaces. The axial position of the IRZ and its shape has been related to a similarity parameter based on the original (throat) swirl levels and the ratio of the local vortex diameter to the original (throat) diameter. However, the flow pattern inside the IRZ and also the existence of an IRZ is better described by a final swirl level based on the original swirl level and the ratio of the furnace diameter and the throat diameter. If a contraction was present at the furnace exit, the flow inside the IRZ could be affected but not the axial position or initial shape of the IRZ. Annular swirling flows were found to react quite differently to simple swirling flows (without a central tube) with both a large diameter expansion ratio and an annular swirling flow being essential to establish a large central reverse IRZ. If a simple swirling flow was used and/or if the flow was highly confined then an annular reverse IRZ was typically found. The ratio of the primary to annular stream velocity was found to be critical in determining the path of a primary non-swirling jet. Increasing the swirl level above that required to establish an IRZ did not necessarily help in deflecting the axial jet earlier and could have the opposite effect. With the assistance of inviscid theory a preliminary model has been proposed which classifies expanding swirling flows into four separate regimes based on the physical properties exhibited by each region. (J.C.R.)

24243 **(IVL-B—761) Energy and environmental optimizing of domestic furnaces designed for solid fuels - literature review.** Bardh, N. (Swedish Environmental Research Inst., Stockholm). Jun 1984. 75p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751458.

A review of the literature is given on how the efficiency and emission parameters of solid-fuel furnaces designed primarily for use with bio-fuels, are influenced by the operating conditions. The review is part of a long term project designed to investigate procedures for optimizing incinerating conditions. A discussion is presented on how incinerating conditions such as temperature, draught, air-flow, loading, and fuel supply affect stack emissions e.g. oxides of nitrogen and sulphur, particulate matter, and uncombusted material. Also discussed are those factors which affect the efficiency of the furnaces, and procedures designed to maintain optimal efficiency.

24244 **(SAND—85-0545C) Laser-induced fluorescence measurement of vapor concentration surrounding evaporating droplets.** Neal, D.R.; Baganoff, D. (Stanford Univ., CA (USA). Dept. of Aeronautics and Astronautics). 1985. Contract AC04-76DP00789. 10p. (CONF-850345—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009409.

From Southwest conference on optics; Albuquerque, NM, USA (4 Mar 1985).

Fuel droplet evaporation plays an important role in liquid fuel combustion systems. Laser-induced iodine fluorescence can be used to make nonintrusive concentration measurements in a plane with good spatial and temporal resolution. Iodine seeded droplets were suspended on a hypodermic needle, and fluorescence was induced in the resulting vapor cloud. Photographs or video images of iodine seeded 1-octanol droplets provided direct measurement of concentration. Quantitative analysis of free falling droplets was obtained by using a photomultiplier tube to image a single point near the droplet. Reconstructions from multiple photomultiplier recordings indicate that the region of maximum concentration is displaced

from the droplet axis and moves behind the drop with increasing Reynold's number.

24245 (STEV-FBA—84-8) Physical modelling of burners. Nilsson, P. (Statens Energiverk, Stockholm (Sweden)). Sep 1983. 66p. (In Swedish). (STUDSVIK-EB—83-119). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751429.

Model tests have been performed in order to verify the mathematical model of a flame. The model of the burner and of the furnace can be compared with a full-scale plant situated at Studsvik Energiteknik AB. The flame of model tests has been simulated by air. By alternately feeding very small sugar particles into the secondary air and the mixture of fuel and primary air, the velocity of the gas and its concentration has been measured by the Laser-doppler-anemometric method.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 23874

24246 (LALP—84-60) Thermal-spallation drilling. (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010383.

Los Alamos MINI-Review.

This brief review discusses the use and potentialities of thermal spallation to drill deep holes in hard rock. Historical experiences, technological improvements, and economics are focused on. (ACR)

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 23418, 23767, 23768

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 24945, 25046

24247 (CONF-8307126—) Physics of high energy particle accelerators. AIP conference proceedings No. 127. Month, M.; Dahl, P.F.; Dienes, M. (eds.). (American Inst. of Physics, New York; Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA)). 1985. Contract AC02-76CH00016. 983p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85008891.

From 3. annual summer school on high energy accelerators; Upton, NY, USA (6 Jul 1983).

Topics covered in this workshop include accelerator physics, particle physics, and new acceleration methods. Eighteen lectures were presented. Individual abstracts were prepared separately for the data base. (GHT)

24248 (SAND—85-0494C) Ionization front accelerator: high gradients, demonstrated particle acceleration, and a proposed relativistic accelerator. Olson, C.L.; Frost, C.A.; Patterson, E.L.; Anthes, J.P.; Poukey, J.W. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 22p. (CONF-850128—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009436.

From 2. international workshop on laser acceleration of particles; Los Angeles, CA, USA (7 Jan 1985).

The Ionization Front Accelerator (IFA) is a collective ion accelerator for which high-gradient particle acceleration has now been demonstrated. In the IFA, the space charge field at the front of an intense relativistic electron beam is controlled by a laser and used to accelerate an ion bunch. Two complete IFA systems have been built (IFA-1 and IFA-2). Here we present initial IFA-2 ion results that demonstrate that ions have been accelerated with controlled accelerating fields of 33 MV/m over 30 cm. Space charge fields of accelerators like the IFA and the plasma beat wave accelerator are compared, and both are shown to be capable of producing fields 1 GV/m and higher. The IFA systems are discussed and initial IFA-2 ion results are presented. Lastly, a relativistic IFA is proposed that should in principle, permit the attainment of virtually unlimited ion energies. 11 references, 8 figures.

24249 (SLAC-PUB—3629) Report of near field group. Palmer, R.B.; Baggett, N.; Claus, J.; Fernow, R.; Stumer, I.; Figueroa, H.; Kroll, N.; Funk, W.; Lee-Whiting, G.; Pickup, M. (Brookhaven National Lab., Upton, NY (USA); California Univ., Los Angeles (USA); California Univ., San Diego, La Jolla (USA); Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.; Cornell Univ., Ithaca, NY (USA)). Apr 1985. Contract AC03-76SF00515. 10p. (CONF-850128—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010536.

From 2. international workshop on laser acceleration of particles; Los Angeles, CA, USA (7 Jan 1985).

Substantial progress since the Los Alamos Workshop two years ago is reported. A radio-frequency model of a grating accelerator has been tested at Cornell, and extensive calculations compared with observations. Alternative structures consisting of either hemispherical bumps on a plane, or conducting spheres in space, have also been rf modeled. The use of liquid droplets to form such structures has been proposed and a conceptual design studied. Calculations and experiments have examined the effects of surface plasmas, and shown that in this case the reflectivity is low. However, calculations and observations suggest that gradients in excess of 1 GeV/meter should be obtainable without forming such plasma. An examination of wake fields shows that, with Landau damping, these are independent of wavelength. The use of near field structures to act as high gradient focusing elements has been studied and shows promise, independent of the acceleration mechanism. A proposal has been made to establish a facility that would enable "proof of principle experiments" to be performed on these and other laser driven accelerator mechanisms. 11 refs., 10 figs.

24250 Stabilized radio frequency quadrupole. Lancaster, H. D.; Fugitt, J. A.; Howard, D. R. (to The United States of America as represented by the United States Department of Energy). US Patent 4,490,648. 25 Dec 1984. Filed date 29 Sep 1982. vp.

PAT-APPL-426363.

A long-vane stabilized radio frequency resonator for accelerating charged particles and including means defining a radio frequency resonator cavity, a plurality of long vanes mounted in the defining means for dividing the cavity into sections, and means interconnecting opposing ones of the plurality of vanes for stabilizing the resonator.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 24219, 24247, 24264

24251 (BNL—36218) Preliminary results on open accelerating structures. Palmer, R.B.; Giordano, S. (Brookhaven National Lab., Upton, NY (USA)). 7 Jan 1985. Contract AC02-76CH00016. 10p. (CONF-850128—14). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010231.

From 2. international workshop on laser acceleration of particles; Los Angeles, CA, USA (7 Jan 1985).

In this paper we consider periodic structures consisting of rows of spherical conductors. In a plasma linac, these spherical conductors would be formed from liquid droplets on whose surfaces a plasma would be formed. For this paper, the field configurations have been investigated using copper spheres approximately 11 cm diameter and microwave radiation of approximately 30 cm wavelength. No suitable accelerating mode was found for relativistic particles using a single row of spheres, but with two parallel rows of spheres both accelerating and focusing modes were found. In Section II we re-examine the accelerating modes over a grating surface, including a grating of parallel conducting rods. In Section III we discuss the coupling of these structures to incoming radiation. 3 refs., 6 figs.

24252 (LA-UR—85-1133) Quasi-analytical description of sideband generation in a FEL. Elliott, C.J. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 16p. (CONF-850345—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009610.

From Southwest conference on optics; Albuquerque, NM, USA (4 Mar 1985).

The connection is established between the one-dimensional model and the sidebands in the square pulse two-dimensional problem. The features occurring in the square pulse problem are shown to be directly derived from the energy loss curve for the one-dimensional problem. Incidentally this work also provides a numerical check for two-dimensional (z,t) calculations. In any such calculation numerical diffusion and roundoff alter results. This quasi-analytical technique provides answers that are limited only by the ability to compute the much simpler one-dimensional problem.

24253 (LBL—18528) Method to render second order beam optics programs symplectic. Douglas, D.; Servranckx, R.V. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AC03-76SF00098. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85010631.

We present evidence that second order matrix-based beam optics programs violate the symplectic condition. A simple method to avoid this difficulty, based on a generating function approach to evaluating transfer maps, is described. A simple example illustrating the non-symplectricity of second order matrix methods, and the effectiveness of our solution to the problem, is provided. We conclude that it is in fact possible to bring second order matrix optics methods to a canonical form. The procedure for doing so has been implemented in the program DIMAT, and could be implemented in programs such as TRANSPORT and TURTLE, making them useful in multiturn applications. 15 refs.

24254 (SLAC-PUB—3572) Quantum effects in linear collider scaling laws. Himel, T.; Siegrist, J. (Stanford Linear Accelerator Center, CA (USA); Lawrence Berkeley Lab., CA (USA)). Feb 1985. Contract AC03-76SF00515. 8p. (CONF-850128—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009846.

From 2. international workshop on laser acceleration of particles; Los Angeles, CA, USA (7 Jan 1985).

Compared to classical calculations, quantum corrections greatly reduce the radiation emitted when the e^+ and e^- beams collide in a linear collider. This allows a given luminosity to be obtained with much lower beam powers by making the beam size smaller.

24255 (SLAC-PUB—3601) Plasma wake field accelerator. Chen, P.; Dawson, J.M. (Stanford Linear Accelerator Center, CA (USA); California Univ., Los Angeles (USA). Dept. of Physics). Mar 1985. Contract AC03-76SF00515. 7p. (CONF-850128—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010538.

From 2. international workshop on laser acceleration of particles; Los Angeles, CA, USA (7 Jan 1985).

A new scheme of electron acceleration, employing relativistic electron bunches in a cold plasma, is analyzed. The wake field of a leading bunch is derived in a single-particle model. We then extend the model to include finite bunch length effect. In particular, we discuss the relation between the charge distributions of the driving bunch and the energies transformable to the trailing electrons. It is shown that for symmetric charge distribution of the driving bunches, the maximum energy gain for a driven electron is $2\gamma_0 mc^2$. This limitation can be overcome by introducing asymmetric charge distributions. 13 refs., 5 figs.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 24247, 24743, 25052

24256 (BNL—36088) One-frequency laser interferometer using the optic fiber as a polarization-independent interference phase detector. Shu, D. (Brookhaven National Lab., Upton, NY (USA)). Feb 1985. Contract AC02-76CH00016. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010544.

A soft x-ray scanning microscope will be built on the NSLS x-ray ring's undulator beam line. It is expected that the beam line will provide more powerful coherent soft x-ray flux to improve the resolution of scanning microscopy to the sub-1000A range and form pictures in seconds rather than minutes. A laser interferometer has been developed for encoding the coordinates of the scanning plane of the soft x-ray microscope with 300A resolution. A pair of the optical fibers has been used as an interference fringe phase detector in the interferometer which can make the system phase adjustment simpler, more accurate, and polarization-independent. The last character is important because if the fringe phase detector is polarization dependent the interferometer's optical design will be complicated when the optical path of the interferometer has to include additional windows or mirrors which usually change the polarization situation. In the first section of this report we discuss the optical arrangement of the interferometer. In the following two sections we describe the schematic of the resolution extending unit and the interferometer's other possible applications.

24257 (CONF-8305258—Summ.) New techniques and potential applications in ultrasensitive mass spectrometry: symposium summary. (National Bureau of Standards, Washington, DC (USA)). 1983. 38p. NTIS, PC A03/MF A01. File Number DE85009043.

From Symposium on new techniques and potential applications in ultrasensitive mass spectrometry; Washington, DC, USA (31 May 1983).

This informal report is a summary of a symposium entitled: new techniques and potential applications in ultrasensitive mass spectrometry held at NBS on May 31, 1983. The agenda is attached, as are the names of most of the 60 people who attended. The objectives of the meeting were to: examine and compare the present and potential capabilities of ultrasensitive atom counting techniques: tandem accelerator mass spectrometry (TAMS), resonance ionization mass spectrometry (RIMS), sputter initiated resonance ionization spectrometry (SIRIS), conventional mass spectrometry (MS), and secondary ion mass spectrometry (SIMS); and examine the range of measurements presently being performed by these instruments and consider the potential for future measurements.

24258 (INIS-BR—158) Study about neutron sources for electron linear accelerators. Goncalez, O.L. (Centro Tecnico Aeroespacial, Sao Jose dos Campos (Brazil). Inst. Tecnologico de Aeronautica). 1982. 122p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780838.

The efficiency of neutron production and residual activity induced by electron incidence from 30 to 200 MeV on thick metalic targets of Al, Sb, Cu, Ir, Hg, Mo, Nb, Ni, Pd, Pt, Ta, Ti, W and Zr is evaluated. As a result of this evaluation, the tantalum, copper and antimony targets are indicated as the more suitable, representating high, low and medium atomic numbers. For the experimental part the Ti, Cu, Nb and Pb were selected as set representatives. The yield measured by the residual activities agree with theoretical calculation. The neutron angular distribution for niobium was measured by indium foil activation. In addition, some general features for 120° Cu and Nb spectra were obtained.

24259 (INIS-mf—9271) Construction and studies of post-accelerator resonators with single and several coupled helices. Rohrbach, W. (Frankfurt Univ. (Germany, F.R.). Fachbereich Physik). 13 May 1983. 172p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780860.

The present thesis is occupied with the development of accelerator resonators with single and with several coupled helices. The main aim was the construction of a post-accelerator section with three coupled helices for the post-accelerator project in the Institute for Nuclear Physics. Furthermore single helices as buncher respectively rebuncher cavities both for the post-accelerator project and for the UNILAC of the GSI were constructed. After a short presentation of the principle of a single helix resonator its properties are described by means of a transmission line theory, because this is very well suited to determine the shant impedance as an important characteristic quantity for accelerators. The electromagnetic coupling which leads in an arrangement of several helices in a resonator to a frequency splitting is described by a chain of oscillatory circuits. Thereby it is possible to regard both the capacitative and the inductive coupling in the model. The experimental studies on the helical structures were performed both at the measuring transmitter level and at high power levels (proportional 100 kW).

24260 **(INIS-mf—9272) Studies on HF quadrupole accelerator structures.** Mueller, J. (Frankfurt Univ. (Germany, F.R.). Fachbereich Physik). 31 Aug 1983. 169p. (In German). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780861.

The present thesis had the aim to elaborate advantages and disadvantages of existing high frequency resonators in the MHz range regarding their use as RFQ power supply structures and to limit their application ranges. After a short survey over potential and field distributions in the RFQ suitable criteria for the valuation of RFQ resonators are indicated. For the experimentally studied resonators equivalent circuits are presented, in some cases these are theoretically analyzed. Finally the construction of the GSI/Frankfurt proton model as well experiments with the accelerated proton beams are described.

24261 **(INIS-mf—9495) [Accelerator Physics at McMaster Univ.]. Annual report, 1982.** (McMaster Univ., Hamilton, Ontario (Canada). Tandem Accelerator Lab.). Nov 1982. 140p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85780857.

Several major upgrading projects were completed during 1982. The original accelerator tubes were replaced with a set of Dowlish spiral inclined field tubes, and the original belt charging system was replaced with a pair of NEC Pelletron charging chains. This has upgraded voltage capacity by at least 1.5 MV and made a significant improvement in voltage stability. A new VAX-11/750 computer was installed, which will allow a more sophisticated approach to multi-parameter data acquisition and analysis. Use of the multiplicity filter to study gamma-ray transitions between high-lying members of bands continues, and will be helped with the voltage upgrading of the tandem and with the VAX. The polarized source, providing both p and d beams, allowed continuing studies of vector and tensor analysing powers. New research programmes in hydrogen depth profiling and studies of infrared absorption in solid hydrogen have begun.

24262 **(INIS-mf—9497) [High Energy Physics Research at Saskatchewan University]. Annual report 1982.** (Saskatchewan Univ., Saskatoon (Canada). Saskatchewan Accelerator Lab.). Nov 1982. 103p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85780859.

The accelerator has run for a respectable number of hours in the past year and apart from the absence of the first section is in excellent health. The experimental programs of electrodisintegration, electron scattering and radiation chemistry are operating well. Considerable development effort has gone into the compatible pion/other hadron detector system and the 0 degrees photodisintegration system but neither of these is ready for experiments yet. A year ago it was reported that a joint proposal with the University of Montreal was made for a 1 GeV electron accelerator. Unfortunately that project was not funded but the request and some other factors did lead to the setting up of an NSERC committee to review the laboratory. On the basis of the recommendations of that committee, a grant application was submitted for major upgrading of the facility to restore it to the world class it once enjoyed.

24263 **Variable aperture neutron collimator. Pt. 2.** Hill, R.A. (Sandia National Labs., Albuquerque, NM (USA)). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **227**: No. 2, 369-372(15 Nov 1984).

A second model of a completely adjustable, variable aperture neutron collimator has been developed. This redesigned model can be scaled to a full-size device appropriate for use in a medical facility. The collimator aperture can be easily adjusted to provide a square or rectangular cross-sectional exposure while maintaining a uniformly diverging line-of-sight from the neutron source.

24264 **Sensitive beam-bunch phase detector.** Takeuchi, S.; Shepard, K.W. (Argonne National Lab., IL (USA). Physics Div.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **227**: No. 2, 217-219(15 Nov 1984).

A sensitive heavy-ion beam-bunch phase detector has been developed by first examining the relationship between the sensitivity of an RF resonant cavity as a particle bunch detector and the shunt impedance of the same cavity as an accelerating structure. Then the various high shunt impedance RF cavities previously developed for accelerating heavy ions were evaluated for use as bunch detectors. A spiral-loaded geometry was chosen, built, and tested with beam. The sensitivity obtained, 14 μ V per electrical nA of beam, is a factor 3 higher than previously reported.

4304 Storage Rings

REFER ALSO TO CITATION(S) 24223, 24247

24265 **(DOE/ER/10716—004) [Electron-proton collider option for the Superconducting Super Collider]. Final report, July 1, 1980-February 28, 1985.** (Columbia Univ., New York (USA)). 1985. Contract AC02-80ER10716. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010146.

The physics of ep collisions has been demonstrated any number of times to be tremendous. If any features of hadron-hadron collisions differ in any essential way from e^+e^- collider phenomena, then it is imperative to have a means of investigating these differences with ep collisions. The uniqueness of the electron-proton collider is in the study of possible wrong-handed contributions to the weak interaction. Therefore the availability of electrons and positrons of either helicity is of the highest priority in the design of the collider. Other problems which are unique to electron-proton colliders are related to the high current multi-bunch nature of the beams required in the colliders. Emphasis has been on the special problems related to making collisions between electron and proton beams.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 23823, 23826, 23827, 23829, 23830, 23831, 23833, 24744

24266 **(IFUSP-P—387) Precise determination of photopeak width.** Helene, O.A.M. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Mar 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700546.

The feasibility and application of very precise determination of photopeak widths observed with Ge(Li) and hyperpure Germanium detectors, are discussed.

24267 **(LA-UR—85-783) Chemical spectroscopy.** Eckert, J.; Brun, T.O.; Dianoux, A.J.; Howard, J.; Rush, J.J.; White, J.W. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 19p. (CONF-8410256—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009594.

From Workshop on scientific opportunities with advanced facilities for neutron scattering; Shelter Island, NY, USA (23 Oct 1984).

The purpose of chemical spectroscopy with neutrons is to utilize the dependence of neutron scattering cross-sections on isotope and on momentum transfer (which probes the spatial extent of the excitation) to understand fundamental and applied aspects of the dynamics of molecules and fluids. Chemical spectroscopy is divided into three energy ranges: vibrational spectroscopy, 25-500 MeV, for which much of the work is done on Be-filter analyzer instruments; low energy spectroscopy, less than 25 MeV; and high resolution spectroscopy, less than 1 MeV, which typically is performed on backscattering spectrometers. Representative examples of measurements of the Q-depenence of vibrational spectra, higher energy resolution as well as extension of the Q-range to lower values at high energy transfers, and provisions of higher sensitivities in vibrational spectroscopy are discussed. High resolution, high sensitivity, and polarization analysis studies in low energy spectroscopy are discussed. Applications of very high resolution spectroscopy are also discussed. (LEW)

24268 **(LBL—17780) Germanium detectors with a built-in transverse drift field.** Luke, P.N.; Madden, N.W.; Goulding, F.S. (Lawrence Berkeley Lab., CA (USA)). Nov 1984. Contract AC03-76SF00098. 8p. (CONF-841007—63). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009944.

From Nuclear science symposium; Orlando, FL, USA (31 Oct 1984).

A new kind of position-sensitive germanium detector based on a novel mode of charge transport is proposed and experimental devices have been fabricated. In these germanium "drift-chambers", position information is obtained by measuring carrier drift times. One-dimensional spatial resolutions of ≅0.5 mm over an active area of ~2.5 x 2.5 cm^2 have been achieved in one detector for 60 keV photons. The simplicity of such detectors makes them attractive as position-sensitive gamma-ray spectrometers compared to discrete element detectors. The problems and limitations of the present detectors are discussed.

24269 **(LBL—19096) Plastic scintillator detectors for the study of transfer and breakup reactions at intermediate energies.** Schmidt, H.R.; Bantel, M.; Chan, Y.D.; Gazes, S.M.; Kamermans, R.; Albiston, C.; Wald, S.; Stokstad, R.G. (Lawrence Berkeley Lab., CA (USA)). Oct 1984. Contract AM03-76SF00326;AC03-76SF00098. 20p. (CONF-841005—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009945.

From Instrumentation for heavy ion nuclear research conference; Oak Ridge, TN, USA (22 Oct 1984).

The detection of light particles associated with projectile like fragments can be used to separate transfer and breakup reactions provided the detectors cover a large solid angle. Three detection systems are described: (1) a π detector in the shape of a cube, 20 cm on a side, (2) a X-Y position sensitive ΔE-E detector having an area of 20 x 20 cm^2, and (3) a multi-element detector consisting of eight position sensitive strips. The latter two detectors are of the phoswich type having the thin element of NE102 (tau = 2.5 ns) and the thick element of NE115 (tau = 225 ns). The performance characteristics of the three detectors are described. 6 references, 13 figures.

24270 **(ORNL—6143) Tenth ORNL Personnel Dosimetry Intercomparison Study.** Swaja, R.E.; Chou, T.L.; Sims, C.S.; Greene, R.T. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE85009818.

The Tenth Personnel Dosimetry Intercomparison Study was conducted at the Oak Ridge National Laboratory during April 9-11, 1984. Dosemeter badges from 31 participating organizations were mounted on 40cm Lucite phantoms and exposed to a range of dose equivalents which could be encountered during routine personnel monitoring in mixed radiation fields. The Health Physics Research Reactor served as the only source of radiation for eight of the ten irradiations which included a low (~ 0.50 mSv) and high (~ 10.00 mSv) neutron dose equivalent run for each of four shield conditions. Two irradiations were also conducted for which concrete- and Lucite-shield reactor irradiations were gamma-enhanced using a ^{137}Cs source. Results indicated that some participants had difficulty obtaining measurable indication of neutron and gamma exposures at dose equivalents less than about 0.50 mSv and 0.20 mSv, respectively. Albedo dosemeters provided the best overall accuracy and precision for the neutron measurements. Direct interaction TLD systems showed significant variation in accuracy with incident spectrum, and threshold neutron dosemeters (film and recoil track) underestimated reference values by more than 50%. Gamma dose equivalents estimated in the mixed fields were higher than reference values with TL gamma dosemeters generally yielding more accurate results than film. Under the conditions of this study in which participants had information concerning exposure conditions and radiation field characteristics prior to dosemeter evaluation, only slightly more than half of all reported results met regulatory standards for neutron and gamma accuracy. 19 refs., 2 figs., 29 tabs.

24271 **(UFRJ-IF—07/82) Angular dependence of cathodic induced signals in a cylindrical proportional detector.** Tur, C.M.; Marechal, B. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700547.

A cylindrical proportional counter with a cathode consisting of eight independent sectors, is used to analyse the pulse height distribution of the induced signals as a function of the polar angle. This distribution is found to be anisotropic, which can in fact be explained assuming that the avalanche does not uniformly surround the anode wire.

24272 **Encapsulated scintillators monitor ^3H-solute concentrations.** Kirk, G.; Gruner, S. (Princeton Univ., NJ). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-29: No. 1, 769-772(Feb 1982). Contract AC02-76EV03120.

The short range of the ^3H beta allows shielding of microbeds of scintillator by a several um thick coating of a water based gel. Gels may be used which are permeable to a wide variety of tritiated molecules. Thus, the light output of a mixture of the coated beads and a solution of the tritiated compound is proportional to the solution concentration of the tritiated substance. The mixture may also contain particles to which the gel is impermeable, such as cells, vesicles, large proteins, etc., but which can alter the concentration of the tritiated compound by uptake or release. In this case, the light output monitors the fractional uptake of the tritiated material. The design criteria for encapsulating the scintillators and dynamically monitoring the scintillation output are discussed. A simple method for encapsulating plastic scintillator microbeads, suitable for monitoring slow concentration changes, is described and tested.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

24273 **(BNL—36091) Thin layered interference mirrors to reduce radiation damage.** Csonka, P.L. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 5p. (CONF-850128—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009763.

From 2. international workshop on laser acceleration of particles; Los Angeles, CA, USA (7 Jan 1985).

Calculations have been performed which show that damage induced by radiation of wavelength lambda, incident on mirrors (and other optical elements) can be significantly reduced by a multilayered construction, in which the layers most sensitive to radiation damage have thickness d << lambda. The layers may or may not be free-standing. The threshold to radiation damage in certain cases is calculated to increase by a factor $\approx 10^2$.

24274 **(SAND—84-1520) Progress report on the TMI-2 equipment examination program: beta radiation damage assessment.** Bennett, P.R. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC07-76ID01570;AC04-76DP00789. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009991.

Terminal blocks and splices were exposed to beta radiation at levels similar to TMI-2. Several techniques including FTIR spec-

troscopy, RAMAN spectroscopy, visual observation, and density profiling were examined for their ability to detect beta radiation surface damage. The sensitivity threshold at which FTIR spectroscopy detected surface damage to terminal blocks was between 10 and 37 Mrad. The threshold for density profiling was between 27 and 54 Mrads for splices. Additionally, the sensitivity threshold to observe a color change, for the splices, was between 10 and 20 Mrads. Consequently, no techniques were found which were sensitive at a dose level of approximately 10 Mrad, comparable to the TMI-2 accident environment.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 23379, 23401, 23442, 23443, 23444, 23445, 23446, 23447, 23448, 23449, 23450, 23451, 23452, 23748, 24256, 24937

24275 (CONF-850142—5) Empirical technique to measure x-ray production and detection efficiencies in the analytical electron microscope. King, W.E. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010270.

From Arizona State University centennial symposium on high-resolution electron microscopy; Tempe, AZ, USA (7 Jan 1985).

In the present work, a technique is proposed to experimentally measure the effective x-ray production and detection efficiency in pure element standards. This technique supplements and in some cases is preferable to the multi-element standard technique. Measurements of effective x-ray production and detection efficiencies are expected to be preferable to the standardless technique in cases where pure element samples can be prepared since the most uncertain parameters in the standardless technique are measured in the proposed technique.

24276 (LA-UR—85-1028) Sensitive detection of tunable diode laser absorption by polarization rotation. Loge, G.W.; Laguna, G.A.; Hartford, A. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 15p. (CONF-850345—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009621.

From Southwest conference on optics; Albuquerque, NM, USA (4 Mar 1985).

Results are presented demonstrating that diode laser absorption sensitivity can be increased by using the Faraday or Kerr effect to rotate the polarization of the source so that crossed polarizers can be used to reduce source noise. The Faraday effect is demonstrated using nitrous oxide in a magnetic field, and the Kerr effect is demonstrated using methyl fluoride in an electric field. Some description of how absorption in an external field causes polarization rotation is presented as well as some conclusions on the types of molecules for which this technique is best suited.

24277 (LBL—17552) Resolution at its current limit: applications of the Berkeley ARM. Gronsky, R. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 14p. (CONF-840848—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009959.

From 42. annual Electron Microscopy Society of America meeting; Detroit, MI, USA (13 Aug 1984).

With a demonstrated point-to-point resolution of 0.16 nm and a theoretical point-to-point resolution of 0.13 nm, the ARM (Atomic Resolution Microscope) currently establishes the operational limit of existing microscopes. The sample of applications presented here shows the manner in which this instrument will be applied to the characterization of both structural and compositional discontinuities in solids at atomic dimensions. These remain areas of critical need and provide ample stimulus for further improvement of instrumental resolution.

24278 (N—85-12332) Helium ionization detection apparatus. Nagai, R. (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1984. 7p. (NASA-TM—77505). NTIS, PC A02/MF A01.

In a gas chromatograph apparatus comprising a gas supply (He carrier gas), a sample injection apparatus, a chromatograph column, a He ion detector, and connecting tubes, a foreign gas (other than He) injection apparatus is installed between the sample injection apparatus and the detector. Mixing of the sample gas and foreign gas takes place readily, the sample gas is always maintained at a stable concentrator range, and accurate measurements are possible, especially at low sample gas concentrations.

24279 (NASA-TM—85792) New technique for calibrating hydrocarbon gas flowmeters. Singh, J.J.; Puster, R.L. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jun 1984. 31p. NTIS, PC A03/MF A01. File Number TI85901297.

A new technique for measuring calibration correction factors for hydrocarbon mass flowmeters has been developed. It is based on Nernst theorem for matching the partial pressure of oxygen in the combustion products of the test hydrocarbon, burnt in oxygen-enriched air, with that in normal air. It has been applied to a widely used type of commercial thermal mass flowmeter for a number of hydrocarbons. The calibration correction factors measured using this technique are in good agreement with the values obtained by other independent procedures. The technique has been successfully applied to the measurement of differences as low as 1% of the effective hydrocarbon content of the natural-gas test samples.

24280 (SAND—84-2322) Stored data acquisition system: update. Greene, S.N.; Hauser, G.C. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010534.

Sandia National Laboratories has developed, and continues to improve and modify, a simple, low-power, inexpensive data acquisition system that retains collected data in semiconductor memory rather than telemetering them in real-time; data are retrieved after the test unit is recovered. The system monitors and digitizes up to eight analog inputs. A microprocessor controls the device, thus making it adaptable to different data acquisition tasks.

24281 Infrared absorption spectroscopy of single particles using photophoresis. Lin, H. (Environmental Chemistry Division, Department of Applied Science, Brookhaven National Laboratory, Upton, New York 11973). *Optics Letters;* **10**: No. 2, 68-70(Feb 1985). Contract AC02-76CH00016.

In situ absorption spectroscopy was performed on a single suspended salt particle using photophoresis. The charged ammonium sulfate particle was levitated in an electric-quadrpole field and illuminated by a CO_2 laser. The size-dependent absorption spectrum of ammonium sulfate particles was observed for the first time to our knowledge at 930-1080 cm^{-1}. The effects of gas pressure and laser power were also determined. For particles approximately 10 μm in diameter, the photophoretic force was observed to be negative.

24282 Automated fail-safe control system for independent operation of two radiation shutters on a rotating-anode x-ray source. Short, M.T.; Eisler, W.J. Jr.; Stevens, F.J. (Argonne National Lab., IL). *Journal of Applied Crystallography;* **16**: 359-360(1983). Contract W-31-109-ENG-38.

The design of certain x-ray-generating rotating-anode devices enables the use of multiple ports through which x-rays can exit for experimental use. However, use of additional ports in such devices raises radiation safety concerns, and all attempts should be made to reduce to a minimum the amount of x-ray exposure. The authors describe here the design of a safety system used with their equipment, which consists of an Elliott GX-20 rotating anode and two Huber precession cameras (models 200 and 206), to allow the simultaneous operation of both precession cameras with operator safety. 2 figures.

24283 Fabry-Perot interferometry using an image-intensified rotating-mirror streak camera. Seitz, W.L.; Stacy, H.L. (Los Alamos National Lab., NM). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **427**: 186-192(1983).

A Fabry-Perot velocity interferometer system is described that uses a modified rotating mirror streak camera to recrod the dynamic fringe positions. A Los Alamos Model 72B rotating-mirror streak camera, equipped with a beryllium mirror, was modified to include a high aperture (f/2.5) relay lens and a 40-mm image-intensifier tube such that the image normally formed at the film plane of the streak camera is projected onto the intensifier tube. Fringe records for thin (0.13 mm) flyers driven by a small bridgewire detonator obtained with a Model C1155-01 Hamamatsu and Model 790 Imacon electronic streak cameras are compared with those obtained with the image-intensified rotating-mirror streak camera (I^2RMC). Resolution comparisons indicate that the I^2RMC gives better time resolution than either the Hamamatsu or the Imacon for total writing times of a few microseconds or longer.

24284 **VISAR: some things you should know.** Hemsing, W.F. (Los Alamos National Lab., NM). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **427**: 144-148(1983).

VISAR performance can be improved while reducing cost, set up time, and required operator skill. Simple features that increase laser light efficiency, improve signal-to-noise ratio, reduce the number of data channels, greatly simplify data reduction, ease VISAR adjustments, and reduce laser wear and tear are discussed. These features were collected, developed, tried, and proven over the last few years and several hundred VISAR shots.

24285 **VISAR: 2 1/2 minutes for data reduction.** Hemsing, W.F. (Los Alamos National Lab., NM). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* **427**: 199-202(1983).

Starting with a pair of signals obtained by electronically subtracting photodetector outputs from any VISAR, it is possible to plot velocity vs time, velocity vs distance, and distance vs time in 2 1/2 minutes using an LSI-11/23 computer. This includes time for six iterations of time shift with the resulting polar plots and operator interactions. The velocity calculating algorithm and a flow chart of the computer program are presented.

24286 **Improved fabrication techniques for infrared bolometers.** Lange, A.E.; Kreysa, E.; McBride, S.E.; Richards, P.L. (Univ. of California, Berkeley). *International Journal of Infrared and Millimeter Waves;* **4**: No. 5, 689-706(1983). Contract AC03-76SF00098.

Techniques are described for producing improved infrared bolometers from doped germanium. Ion implantation and sputter metalization have been used to make ohmic electrical contacts to Ge:Ga chips. This method results in a high yield of small monolithic bolometers with very little low-frequency noise. When one of these chips is used as the thermometric element of a composite bolometer, it must be bonded to a dielectric substrate. The thermal resistance of the conventional epoxy bond has been measured and found to be undesirably large. A procedure for soldering the chip to a metalized portion of the substrate is described which reduced this resistance. The contribution of the metal film absorber to the heat capacity of a composite bolometer has been measured. The heat capacity of a NiCr absorber at 1.3 K can dominate the bolometer performance. A Bi absorber has significantly lower heat capacity. A low-temperature black-body calibrator has been built to measure the optical responsivity of bolometers. A composite bolometer system with a throughput of $\sim$ 0.1 sr cm^2 has been constructed using our new techniques. In negligible background, it has an optical NEP of 3.6×10^{-15} w/$\sqrt{\text{Hz}}$ at 1.0K with a time constant of 20 ms. The noise in this bolometer is white above 2.5 Hz and is somewhat below the value predicted by thermodynamic equilibrium theory. It is in agreement with calculations based on a recent nonequilibrium theory.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 23492

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

24287 **(SAND—84-1974C) Single-pulse Raman and photoacoustic spectroscopy studies of triaminotrinitrobenzene (TATB) and related compounds.** Trott, W.M.; Renlund, A.M.; Jungst, R.G. (Sandia National Labs., Albuquerque, NM (USA)). 1985. Contract AC04-76DP00789. 8p. (CONF-850345—15). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010072.

From Southwest conference on optics; Albuquerque, NM, USA (4 Mar 1985).

Pulsed-laser-excited Raman scattering methods and photoacoustic spectroscopy have been applied to the study of porous, granular samples (i.e., pressed pellets) of 1,3,5-trinitrobenzene (TNB), 1-amino-2,4,6-trinitrobenzene (MATB), 1,3-diamino-2,4,6-trinitrobenzene (DATB) and 1,3,5-triamino-2,4,6-trinitrobenzene (TATB). Single-pulse spontaneous Raman spectra have been obtained for all four materials. Using 532-nm excitation, the intensity of the background emission observed with the Raman scattered light varies as TNB > MATB > DATB > TATB. This trend is compared to information on the long-wavelength absorption edge of MATB, DATB and TATB as determined by the photoacoustic spectra of these materials. Stimulated Raman scattering has been observed for three of the compounds with conversion efficiency as follows: DATB > TATB > MATB. In the case of TATB, this process may be limited by photo-induced chemical reactions. The relatively efficient formation of one or more stable photolysis products in TATB is evident on the basis of its photoacoustic spectrum. Preliminary single-pulse Raman scattering measurements on shocked TATB are also described. 16 references, 13 figures, 2 tables.

24288 **(UCRL—92420) Detonation behavior of LX-14 and PBX-9404: theoretical aspect.** Ree, F.H.; van Thiel, M. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 13p. (CONF-850706—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010038.

From 8. international symposium on detonation; Albuquerque, NM, USA (15 Jul 1985).

We recently developed an a priori theory of statistical mechanics to describe post-detonation behavior of explosives. It is based on (1) reliable intermolecular potentials, (2) an accurate statistical mechanical theory of mixtures, and (3) an efficient technique to handle reactive multiphase mixtures. We have computed the detonation properties of LX-14 and PBX-9404. The Gibbs free energy of the mixture indicates that nitrogen will phase-separate from the rest of detonation products as do graphite or diamond. The theoretical Chapman-Jouguet (CJ) detonation velocities agree well with experiment, but the CJ pressures show a small discrepancy. We suggest that CJ experiments have been insensitive to slow carbon formation. Theoretical results of overdriven shocks, the CJ adiabat, and several useful fits to the theory are discussed. 30 references, 7 figures, 5 tables.

4503 Explosion Detection

24289 **(SAND—84-1507) Surface wave seismic yields as measured by the Regional Seismic Test Network.** Garbin, H.D. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1985. Contract AC04-76DP00789. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010532.

Long period surface wave data recorded by the Regional Seismic Test Network (RSTN) are being analyzed for use as a yield index. We demonstrated that short period yield estimates require a large number ($\sim$10) of calibration events in a very localized region before we have a reasonable degree of confidence in the yield.

Since it is probably not feasible to have the required number of calibration events in a threshold test ban treaty, it is hoped that the longer period waves will average out the source region over a larger area and be less affected by small anomalies. The results of the study are promising, and the following conclusions were reached: the surface wave detection threshold is much higher than for short period waves; Rayleigh wave amplitude calibration curves are not much of an improvement over the short period results; and tectonic strain release accounts for a significant portion of energy in the signal, and if a normal strike-slip source is assumed, corrections can be made to reduce the rms to 1.22 in the frequency window from 0.04 to 0.07 Hz.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 25084, 25085, 25086, 25087, 25088, 25089

24290 **(INPE—2567) Incoming solar radiation estimates at terrestrial surface using meteorological satellite.** Arai, N.; Almeida, F.C. de. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Nov 1982. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700514.

From 2. Brazilian Congress of Meteorology; Pelotas, RS (Brazil) (1982).

By using the digital images of the visible channel of the GOES-5 meteorological satellite, and a simple radiative transfer model of the earth's atmosphere, the incoming solar radiation reaching ground is estimated. A model incorporating the effects of Rayleigh scattering and water vapor absorption, the latter parameterized using the surface dew point temperature value, is used. Comparisons with pyranometer observations, and parameterization versus radiosonde water vapor absorption calculation are presented.

24291 **Spatial and temporal characteristics of Northern Hemisphere surface air temperature variations.** Jones, P.D.; Kelley, P.M. (Univ. of East Anglia, Norwich, England). *J. of Climatology;* **3**: 243-252(1983). Contract AC02-81EV10739;AC02-79EV10098.

The spatial and temporal characteristics of variations in surface air temperature over the Northern Hemisphere landmasses during the present century are determined. The spatial patterns of change accompanying major warming and cooling episodes are mapped. The spatial representativeness of the Northern Hemisphere average is assessed and implications for proxy climate studies are considered. Finally, the seasonal breakdown of trends and correlations between monthly and annual data for the Arctic and Northern Hemisphere is considered. It is shown that, although generally similar, significant differences in the spatial patterns of change accompanying warming and cooling in the Northern Hemisphere average have occurred. In particular, the early 20th century warming was more coherent spatially (as well as more rapid and stronger) then either the cooling that followed or the recent warming. Various regions tend to vary consistently with the Northern Hemisphere average but the relationships are not as marked or widespread as some investigators have claimed or assumed. The annual Northern Hemisphere average is shown to be more strongly correlated with late spring and summer temperatures than with winter temperatures (although in the latter season the variability is greatest). Trends in temperature over the Northern Hemisphere have been strongest in April and May, whereas over the Arctic they have been strongest in January. This seasonal distribution may give an indication of the physical mechanisms underlying these climatic variations. 23 references, 6 figures, 2 tables.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 23414, 23714, 23753, 23754, 23755, 23756, 24153, 24164, 24320

24292 (CONF-830669—, pp 17-23) **Overview: climate and energy interactions.** Landsberg, H.E. (Univ. of Maryland, College Park). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

Climate is all-pervasive in energy production, energy transportation, and energy consumption. It is a primary concern in the siting of power plants, especially as regards atmospheric transport of pollutants. Climatic extremes present hazards to many energy installations, including off-shore drilling platforms, transmission towers, and even underground coal mines. Climatic modifications, actual and potential, by use of fossil fuels in form of acid rain and the warming effect of carbon dioxide accumulation need more study. More use of available climatic information by the energy industries is indicated.

24293 **(IMG-TNO-G—1236) Air Pollution by coal.** Den Tonkelaar, W.A.M. (Instituut voor Milieuhygiene en Gezondheidstechniek TNO, Delft (Netherlands)). Feb 1983. 54p. (In Dutch). Instituut voor Milieuhygiene en Gezondheidstechniek TNO, Delft, Netherlands.

With the aid of the calculation model Air Pollution the effects on air quality are calculated when heating is changed to the firing of coal in fluidized beds or chain grates in the glass horticulture near Aalsmeer and in reference areas of 1 sq.km heated glass in Northern and Southern Holland. As an example the concentrations of BaP (benzo(a)pyrene, 3,4 benzopyrene) in the surroundings of a single plant are calculated. Although changing to coal firing in the above mentioned areas will lead to a relatively large worsening of the air quality the maximum allowable concentrations will only be exceeded slightly or locally. In the southern Netherlands the allowable concentrations for 95% and 98% sulfur dioxide will be exceeded, due to the fact that concentrations are high already. (J.C.R.)

24294 **(LBL—18188) Concentrations of indoor pollutants data base: a status report.** Brown, S.R.; Young, R.A.; Grimsrud, D.T. (Lawrence Berkeley Lab., CA (USA)). Jul 1984. Contract AC03-76SF00098. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010629.

A computerized data base of field research in indoor air quality in the United States and Canada is being implemented in a microcomputer environment using IBM PC microcomputers and commercial software. The data base contains bibliographic information and summary data from the experiments cited. Programs have been written to provide extensive search and retrieval capabilities that are "user-friendly" and require minimal knowledge of microcomputers and data base software.

24295 **(LBL—18754) Applied Science Division annual report, Environmental Research Program FY 1984.** Cairns, E.J.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Mar 1985. Contract AC03-76SF00098. 145p. NTIS, PC A07/MF A01; GPO Dep. File Number DE85010637.

The objective of the Environmental Research Program is to understand the formation, transformation, transport, and effects of energy-related pollutants on the environment. The effects studied include those on global, regional, and local scales and involve the atmosphere, hydrosphere, and biosphere. This multidisciplinary research program includes fundamental and applied research in physics, chemistry, engineering, and biology, as well as research on the development of advanced methods of measurement and analysis. During FY 1984, research concentrated on atmospheric physics and chemistry, applied physics and laser spectroscopy, combustion theory and phenomena, environmental effects of oil shale processing, toxicology studies of biological systems, and trace element analysis for the investigation of present and historical environmental impacts.

24296 (ORNL—6140) Environmental Sciences Division annual progress report for period ending September 30, 1984. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 200p. NTIS, PC A09/MF A01; GPO Dep. File Number DE85010452.

Environmental Sciences Division Publication No. 2454.

The accomplishments of the Environmental Sciences Division in the areas of acid rain and related environmental effects, the global carbon cycle, hazardous chemical and radioactive waste disposal, and development of commercial biomass energy production systems are outlined. (ACR)

24297 (RFP—3683) Terrain-Responsive Atmospheric Code (TRAC) for plume growth and dispersion in complex terrain. Hodgin, C.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 3 Apr 1985. Contract AC04-76DP03533. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010541.

Use of atmospheric dispersion models to assess pollutant impacts in complex terrain is increasing. However, the temporally and spatially varying wind and turbulence fields in mountainous areas often invalidate the assumptions of straight-line flow and horizontal homogeneity inherent in standard plume models. A dispersion model was recently developed at the Rocky Flats Plant to realistically simulate dispersion processes in complex terrain. The new model treats pollutant releases as a series of overlapping ellipsoidal puffs. The ends of each puff axis are defined by "tracer" particles, which are independently advected through the modeled windfield. The puff axes are not, in general, orthogonal. Thus, a puff can develop an arbitrary shape in response to differential diffusion rates, horizontal convergence and divergence, vertical shear, surface reflection, and gravitational settling. The model includes modules for puff transport, diffusion, wet and dry deposition, resuspension, surface roughness effects, ingrowth, decay, and external and internal dosimetry. This report focuses on the simulation of puff growth and shape.

24298 (UCID—20388) Analysis and model/data comparisons of large-scale releases of nitrogen tetroxide. McRae, T.G. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 78p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85009989.

A series of large-scale spills (3 to 5 m^3) of nitrogen tetroxide (N_2O_4) was performed at the Nevada Test Site (NTS) for the Air Force Engineering and Services Laboratory, Environics Division. The purpose of these experiments was to study the evaporation rates and heavy gas dispersion aspects of realistic size releases of N_2O_4, a rocket fuel oxidizer for the Titan II missile system. The Titan II complexes are currently being decommissioned, resulting in an increase in the overland transportation of this toxic material. The N_2O_4 vapor is heavier-than-air and forms a nitric acid mist in close to the spill area. As it disperses downwind, it dissociates to nitrogen dioxide (NO_2), which has a TLV level of 3 ppm. The field experiment is described and the accuracy of the experimental results are discussed. The predictions of several source strength and simple Gaussian dispersion models are compared to the results. (38 references, 20 figures, 10 tables.

24299 Influence of storm characteristics on sulfate in precipitation. Bloxam, R.M.; Hornbeck, J.W.; Martin, C.W. (Atmospheric Environment Service, Downsview, Ontario). *Wasp, Air, and Soil Pollution;* **23**: No. 4, 359-374(1984). Contract FG01-80EV10455.

The effects of storm dynamics on precipitation chemistry were examined using an atmospheric budget for SO_4/sup =/. One hundred storms occurring between 1975 and 1978 at Hubbard Brook Experimental Forest in New Hampshire were used as test data. Concentrations of major ions were usually greater in convective storms than in continuouus or layer storms. For example the geometric mean concentrations of SO_4/sup =/ in convective and continous storms were 4.1 and 1.1 mg L^{-1}, respectively. Higher SO_4/sup =/ concentrations also occurred when surface wind direction were south or southwest. The summer maximum in convective activity along with the seasonal dependence of surface wind directions and the seasonal atmospheric chemistry cycle can account for the summer maximum in SO_4/sup =/ concentrations observed in the northeastern United States. 22 references, 5 figures, 4 tables.

24300 Acid rain. Stensland, G.J. (Illinois Dept. of Energy and Natural Resources, Champaign). *Encyclopedia of Environmental Science and Engineering;* **1**: 1-9(Nov 1983).

A series of definitions for the field of acid rain studies are presented. Protocols for acid rain sampling and monitoring are also presented. A procedure for calculatory precipitation pH is discussed. 11 references, 1 table.

24301 Heavy metals: solubility in atmospheric deposition. Gatz, D.F.; Warner, B.K.; Chu, L.C. (Illinois State Water Survey, Champaign). *International Conference on Heavy Metals in the Environment;* **1**: 183-186(Sep 1983). Contract AC02-76EV01199.

Zn, Cu, Cd, and Pb were found to have larger soluble fractions in precipitation-only (wet) samples than in dry or bulk (wet + dry) deposition samples. Zn and Cd were, in the mean, the most (and about equally) soluble, followed by Cu and then Pb. As in other natural waters, insoluble materials decreased metal solubilities in these samples. This explains why dry and bulk samples, with generally larger concentrations of insoluble materials, have generally smaller metal solubilities, relative to wet samples. 4 references, 2 figures.

24302 Z-DNA and the polytene chromosome. Pardue, M.L.; Nordheim, A.; Lafer, E.M.; Stollar, B.D.; Rich, A. (Massachusetts Inst. of Tech., Cambridge; Tufts Univ. School of Medicine, Boston, MA). pp 171-176 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY ; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

Indirect immunofluorescence shows that antibodies specific for the Z conformation of DNA bind to D. melanogaster polytene chromosomes in a specific and reproducible pattern. In our acetic-acid-fixed preparations, the binding is predominantly to interband regions, to puffs, and to some specific bands. As might be expected, the pattern of binding can be affected by cytological procedures. Bands and interbands show significant differences in their susceptibility to these procedures. Although further study is needed, our studies give no evidence that acetic acid treatment of intact cells is capable of causing conversion of B-form and Z-form DNAs. Instead, the experiments suggest that the Z conformation is preferentially available in interbands and a few other chromosome regions. 21 references, 4 figures.

24303 Deposition of SO_2 on ground cover. Murphy, B.D. (Oak Ridge National Lab., TN). pp 500-505 of Third symposium on atmospheric turbulence, diffusion and air quality. Boston, MA; American Meteorological Society (1976). (CONF-761003—).

From Symposium on atmospheric turbulence, diffusion, and air quality; Raleigh, NC, USA (19 Oct 1976).

Dry deposition is a complicated process and the details of its occurrence for various kinds of ground cover are not well understood. The dry deposition problem is addressed with particular reference to SO_2. A method is outlined which calculates deposition velocity as the reciprocal of a resistance. This resistance, in turn, is a sum of three separately identifiable components: an aerodynamic resistance, a surface layer resistance, and a surface-specific resistance reflecting the condition of the foliage which is considered to be the eventual sink for the material being deposited. Deposition of SO_2 has been considered in illustrating the model. 20 references, 5 figures.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 23872, 24315, 24316

24304 **(JAERI-M—83-201) Meteorological statistics at the site of Tokai Research Establishment (1964-1982).** Obata, Kazuichi; Katagiri, Hiroshi; Kobayashi, Hideo; Yabuta, Hajimu; Kokubu, Morinobu. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 44p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700892.

Results of meteorological observations such as wind speeds, wind directions, air temperatures, precipitation and relative humidity on the site of Tokai Research Establishment from 1964 to 1982 are summarized in the form of meteorological statistics.

24305 (NIRS-M—42, pp 37-47) **Consideration on the tritium deposition in Tokyo and the tritium distribution in the seawater of Pacific Ocean.** Katsuragi, Yukio (Meteorological Research Inst., Yatabe, Ibaraki (Japan)). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

Some studies on the tritium in the atmosphere, precipitation, and seawater have been made. The author has presented discussions on (a) the altitudinal, seasonal, and local variation of the tritium concentration in the atmosphere, and (b) the latitudinal and depth distribution of tritium in the Pacific Ocean. The deposition data showed the difference between the behavior of the tritium in the atmosphere and that of Sr-90 and Cs-137. The tritium distribution in the surface water of the Pacific Ocean fairly depends on the tritium fallout distribution, and the depth distribution was related with the temperature of seawater and the density of seawater body.

24306 **(NUREG/CR—4158) Compilation of information on uncertainties involved in deposition modeling.** Lewellen, W.S.; Varma, A.K.; Sheng, Y.P. (Aeronautical Research Associates of Princeton, Inc., NJ (USA)). Apr 1985. 74p. (ARAP—504). NTIS, PC A04/MF A01 - GPO $4.50. File Number TI85901272.

The current generation of dispersion models contains very simple parameterizations of deposition processes. The analysis here looks at the physical mechanisms governing these processes in an attempt to see if more valid parameterizations are available and what level of uncertainty is involved in either these simple parameterizations or any more advanced parameterization. The report is composed of three parts. The first, on dry deposition model sensitivity, provides an estimate of the uncertainty existing in current estimates of the deposition velocity due to uncertainties in independent variables such as meteorological stability, particle size, surface chemical reactivity and canopy structure. The range of uncertainty estimated for an appropriate dry deposition velocity for a plume generated by a nuclear power plant accident is three orders of magnitude. The second part discusses the uncertainties involved in precipitation scavenging rates for effluents resulting from a nuclear reactor accident. The conclusion is that major uncertainties are involved both as a result of the natural variability of the atmospheric precipitation process and due to our incomplete understanding of the underlying process. The third part involves a review of the important problems associated with modeling the interaction between the atmosphere and a forest. It gives an indication of the magnitude of the problem involved in modeling dry deposition in such environments. Separate analytics have been done for each section and are contained in the EDB.

24307 **(SSI-K—82-08) Airborne particulate radioactivity in Sweden. 4th quarter 1982.** (Statens Straalskyddsinstitut, Stockholm (Sweden)). Apr 1983. 8p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700893.

Preliminary summary is given of fallout gamma activity at ground level for the stations Kiruna, Umeaa, Grindsjoen and Ljungbyhed. 18 nuclei (isotopes) are reported for the period October through December 1982.

5006 Regulations

REFER ALSO TO CITATION(S) 23756, 24427

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 23877

24308 **(BFR-R—60-1984) Environmental effects from natural heat collecting systems. Building Research Council Seminar, October 1983.** Haard, S. (Statens Raad foer Byggnadsforskning, Stockholm (Sweden)). 1984. 207p. (In Swedish). (CONF-8310377—). NTIS (US Sales Only), PC A10/MF A01. File Number DE85751427.

From Building Research Council seminar on environmental effects from natural heat collecting systems; Aspenaesgaarden, Sweden (24 Oct 1983).

Environmental effects from natural heat collecting systems. Building Research Council Seminar, October 1983. Recent efforts to extract energy for building heating and for domestic consumption from soil, water or air instead of using combustion of coal or oil may cause negative environmental effects. Too little is yet known of possible damage if such methods are used on a large scale and with yet not fully developed techniques. For that reason the Swedish Building Research Council has initiated a research program into environmental effects of so called natural heat systems. This conference is intended to help spread information about the program, its development, certain research results and to catalyse exchange of experience. At the same time this report about the seminar represents the first full documentation of the present state of knowledge in this field in Sweden.

24309 **(PSW—58) Dynamics and management of Mediterranean-type ecosystems: proceedings of symposium.** (Forest Service, Berkeley, CA (USA). Pacific Southwest Forest and Range Experiment Station; San Diego State Univ., CA (USA)). Jun 1982. Contract FG01-81EV10724. 683p. (CONF-8106339—). NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85011082.

From Symposium on dynamics and management of Mediterranean-type ecosystems; San Diego, CA, USA (22 Jun 1981).

This symposium proceedings on Mediterranean-type ecosystems includes papers on management, vegetation, fauna, soils, hydrology, fire, and planning. Papers have been individually abstracted for inclusion into the data base. (ACR)

24310 **(SNV-PM—1819) Changes in the oceanic lichen flora of Sweden.** Loefgren, O.; Moberg, R. (Statens Natuurvaardsverk, Solna (Sweden)). May 1984. 52p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751414.

Lichens are sensitive to air pollution and changes in microclimate. In the present study the status of twenty lichen species with an oceanic distribution pattern in Sweden has been investigated. The field work was carried out in 1979 to 1982 and as a reference a comprehensive investigtion from 1935 was used. Most localities harbouring the oceanic lichen species in the period prior to 1935 were visited. A number of localities discovered after 1935 (mainly in North of Sweden) were also investigated. The presence of oceanic lichen species as well as their condition was noted. An effort was also made to assess impact of environmental changes affecting the localities, such as forest management and air pollution. The localities of the oceanic lichens have been classified into seven different groups of habitats. It is concluded that the majority of the oceanic lichens species still present in Sweden are seriously threatened by extinction. Although the major threat in Southwestern Sweden seems to be the increasing level of air pollution, it is argued that efforts should be made also in these parts of the country to protect localities still harbouring oceanic lichens as reference areas for future studies. Measures for conservation of habitats con-

taining oceanic lichens are discussed. Six localities are suggested for conservation.(author).

24311 **Plant-soil processes in Eriophorum vaginatum tussock tundra in Alaska: a systems modeling approach.** Miller, P.C.; Miller, P.M.; Blake-Jacobson, M.; Chapin, F.S. III; Everett, K.R.; Hilbert, D.W.; Kummerow, J.; Linkins, A.E.; Marion, G.M.; Oechel, W.C. (San Diego State Univ., CA). *Ecological Monographs;* **54**: No. 4, 361-405(Dec 1984). Contract AC03-77EV01525.

The Arctic Tundra Simulator (ARTUS) is a computer-based simulation model of Eriophorum vaginatum tussock tundra ecosystems found in north central Alaska. ARTUS simulates the annual patterns of heat and water balance, carbon fixation, plant growth, and nitrogen and phosphorus cycling. ARTUS runs in 1-d time steps for a growing season from May 1 to September 17 and is intended to run for several years. The abiotic section of ARTUS encodes the seasonal input of the environmental driving variables and calculates the resultant thermal and water regimes to define the heat and water environments for the tussock tundra system. The primary driving variables are daily total solar radiation, air temperature, precipitation, surface albedo, wind, and sky conditions. The soil compartment contains three organic horizons, which are recognized by their state of physical and chemical decomposition, and one mineral horizon. Six vascular plant species and four moss species are simulated. The model has seven compartments for each vascular plant species: total nonstructural carbohydrates, total nitrogen, total phosphorus, leaves grown in the current season, leaves grown in previous years, conducting and storage stems plus roots, and absorbing roots. In ARTUS the functional unit of the plant is the shoot system or ramet. Each shoot system consists of leaves, stems, fine roots (which do not have secondary growth and have a limited life-span), and larger roots, which have secondary growth and an extended life-span. Although plant processes are based on individual shoots, the ARTUS model as a whole is based on a square meter of ground. Values per square meter are calculated from the values per shoot by multiplying by the shoot density of each species. 80 references, 7 figures, 18 tables.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 24157, 24296, 24320

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 24296

24312 **(CEGB-RD/B—5200/N84) Models for the evaluation of ingestion doses from the consumption of terrestrial foods following an atmospheric radioactive release.** Nair, S. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1984. 106p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85700899.

Various methods are described which have been incorporated in the FOODWEB module of the CEGB's NECTAR environmental code and are currently being used within CEGB to assess ingestion doses from consumption of terrestrial foods following an atmospheric radioactive release. Four foodchain models which have been developed within CEGB are fully described and results of typical calculations presented. Also given are the results of a validation of the dynamic model against measured ^{90}Sr and ^{137}Cs levels in milk in the U.K. resulting from weapons fallout. Methods are also described for calculating individual and population doses from ingestion using the results of the model calculations. The population dose calculations utilise a data base describing the spatial distribution of production of a wide range of agricultural products. The development of such a data base for Great Britain is described, based on the 1972 land use and livestock census, and maps are presented for each agricultural product.

24313 (NIRS-M—42, pp 141-155) **Behaviors of tritium in terrestrial biological system.** Inomata, Tsuyako (Tohoku Univ., Sendai (Japan). School of Medicine). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

The in vivo behaviors of HTO-^{3}H in food chain models in experimental animals were described. Of pregnant mice that had ingested HTO and drinking water alone for 19 days, the total ^{3}H content in the tissue/wet weight was greater by 20% in fetuses and newborns than in mothers, and the proportion of tissue-bound ^{3}H was 8-24% in mothers and 3% in fetuses. The mean ^{3}H concentration in the free water in tissues was about 36% of ingested HTO. When only ^{3}H foods were ingested for 18 days, the total ^{3}H content in the tissue/wet weight showed no marked difference among the mother, fetuses and newborns, nor did the bound ^{3}H level show great differences. With respect to the tissue distribution of ^{3}H, only the incorporation rate by the mother's brain from HTO was satisfactory, whereas in other organs, the mother, fetuses and newborns showed higher incorporation rates from ^{3}H foods. The ratio of specific radioactivity of soft tissue ^{3}H in mothers to HTO in drinking water exceeded 1 only for the spleen, but other tissues showed no biological concentration. Again, no biological concentration was observed with ^{3}H foods. Environmental HTO did not result in biological concentration of ^{3}H in mother mice that had ingested ^{3}H foods, but ^{3}H was rather diluted. Tissues other than the spleen showed similar values of ^{3}H ingestion from environmental HTO through all routes. However, the proportion of bound ^{3}H in the total ^{3}H in the soft tissue was about 1.4-1.6 times that on ingestion of HTO alone.

24314 (NIRS-M—42, pp 167-180) **Incorporation and in vivo distribution of tritiated water.** Ueno, Yori (Kyoto Univ. (Japan). Faculty of Medicine). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

Behaviors of tritiated water were studied in mammals from individual level to in vivo high molecular level. When mice were given HTO intra peritoneally (i.p.) and were accommodated together with non-contaminated mice in a small room, ^{3}H rapidly transferred to the non-contaminated mice (horizontal contamination) and to fetuses in pregnant mice (vertical contamination). The effective half-life of HTO excreted from each animal fluctuated depending on physiologic conditions. At tissue level, after a single i.p. administration of HTO into mice, the tissue content showed small differences 1 day later, but on the 104th day, the content was smallest in the liver and largest in the lens. When chronically administered as drinking water, ^{3}H in tissues increased rapidly, but when the water was withdrawn, a similar decrease to that after single administration was noted. At high molecular level, ^{3}H excretion from the mouse muscle under chronic administration was similar to that from actomyosin, and excretion from the skin, similar to that from collagen. A similar relation was inferred between the lens and crystallin. Amounts of ^{3}H in actomyosin differed depending on the amino acids.

24315 **Air-to-vegetation transfer rates of natural submicron aerosols.** Bondietti, E.A.; Hoffman, F.O.; Larsen, I.L. (Oak Ridge National Lab., TN (USA)). *Journal of Environmental Radioactivity (London);* **1**: No. 1, 5-27(1984).

Submicron aerosol deposition to outdoor vegetation was evaluated by measuring vegetation and air concentrations of ^{212}Pb, ^{214}Pb, and ^{7}Be attached to atmospheric aerosols. A biomass-normalized deposition velocity (Vsub(D)), with units of $m^3\ kg^{-1}s^{-1}$, was used to compare species and isotopes with respect to air-to-vegetation transfer rates. For ^{212}Pb (tsub(1/2) = 10.64 h), higher night-time air concentrations dominate deposition, while for ^{214}Pb (tsub(1/2) = 26.8 min), deposition measurements over shorter time periods relative to changing atmospheric conditions were possible. Calculated Vsub(D) values were usually higher for ^{214}Pb, possibly reflecting wind-enhanced deposition during the afternoon period of sampling. Evergreen species, including pines, were not appreciably different from deciduous species. Most striking was the narrow range of results (factor of 6 for 34 ^{212}Pb measurements of 20 species). Beryllium-7 (tsub(1/2) = 53.3 d) was used to evaluate time-integrated deposition by-sampling vegetation in California near the

end of dry summers. Similar deposition rates were found for this isotope. The results of the study indicated that naturally radioactive atmospheric aerosols can be used to understand the dynamics of submicron aerosol deposition to ecosystems.

24316 **Radiological dose assessments of atolls in the Northern Marshall Islands.** Robison, W.L. (Lawrence Livermore National Lab., CA). *Proceedings of the National Council on Radiation Protection and Measurements;* No. 5, 40-82(1 Nov 1983). (CONF-830460—). Contract W-7405-ENG-48.

From 19. annual meeting of the National Council of Radiation Protection and Measurements; Washington, DC, USA (6 Apr 1983).

Methods and models used to estimate the radiation doses to a returning population of the atolls in the Marshall Islands are presented. In this environment natural processes have acted on source-term radionuclides for nearly 30 years. The data bases developed for the models, and the results of the radiological dose analyses at the various atolls are described. The major radionuclides in order of their contribution to the total estimated doses were ^{137}Cs, ^{90}Sr, $^{239,240}Pu$, ^{241}Am, and ^{60}Co. Exposure pathways in order of their contribution to the estimated doses were: terrestrial food chain, external γ, marine food chain, inhalation, and cistern water and ground water. 56 references, 13 figures, 16 tables.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 23570, 23571, 24474

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

24317 **Effect of shading by the table coral Acropora Hyacinthus on understory corals.** Stimson, J. (Univ. of Hawaii, Honolulu). *Ecology;* **66**: No. 1, 40-53(Feb 1985). Contract AC08-76EV00703.

Field surveys at Enewetak Atoll, Marshall Islands, show that coral density and diversity is much lower beneath Acropora table corals than in adjacent unshaded areas. Additionally, the understory community is predominantly composed of massive and encrusting species, while branching Acropora and Pocillopora predominate in unshaded areas. Results of experiments in which coral fragments were transferred to the shade of table Acropora and to adjacent unshaded areas show that shading slows the growth and leads to higher mortality of branching species, while massive and encrusting species are unaffected. Light measurements made beneath table Acropora show that illumination and irradiance values fall to levels at which most hermatypic corals do not occur. The fast-growing but fragile table Acropora are abundant in a wide variety of atoll habitats and grow rapidly to form a canopy $\approx$ 50 cm above the substrate. However, table Acropora also have high mortality rates, so that there is continuous production of unshaded areas. The growth and death of tables thus create local disturbances, and the resulting patchwork of recently shaded and unshaded areas may enhance coral diversity in areas of high coral cover.

24318 **Zooplankton grazing in a eutrophic lake: implications of diel vertical migration.** Lampert, W.; Taylor, B.E. (Max Planck Institute for Limnology, Ploen, West Germany). *Ecology;* **66**: No. 1, 68-82(Feb 1985).

During summer and fall, depth profiles of zooplankton community grazing were determined in situ during day and night in the Schoehsee, a small eutrophic lake. Labeled algae of two different sizes were mixed with the natural suspension of phytoplankton in a grazing chamber. A small blue-green alga (Synechococcus, 1 μm) was labeled with ^{32}P; a larger green alga (Scenedesmus, 4-15 μm) was labeled with ^{14}C. During summer, grazing in the upper 5 m was negligible during day but strong at night. Hence, algae grow relatively unimpeded by grazing during daytime but are harvested at night. Vertical and diel differences in grazing rates disappeared when the vertical migration ceased in fall. Selectivity of grazing was controlled by the zooplankton species composition. Eudiaptomus showed a strong preference for Scenedesmus. Daphnia showed a slight preference for Scenedesmus, but Ceriodaphnia preferred Synechococcus. Cyclopoid copepodites did not ingest the small blue-green. Because Daphnia and Eudiaptomus were dominant, grazing rates on larger cells were usually higher than grazing rates on the small cells. Negative electivity indices for scenedesmus occurred only when the biomass of large crustaceans was extremely low (near the surface, during day). Zooplankton biomass was the main factor controlling both vertical and seasonal variations in grazing. Highest grazing rates (65%/d) were measured during fall when zooplankton abundance was high. Because differential losses can produce substantial errors in the results, it was necessary to process the samples on the boat immediately after collection, without preservation.

24319 **Influence of food quality and temperature on life history characteristics of the parthenogenetic mayfly, Cloeon triangulifer.** Sweeney, B.W.; Vannote, R.L. (Academy of Natural Sciences of Philadelphia, Avondale, PA). *Freshwater Biology;* **14**: No. 6, 621-630(Dec 1984). Contract AC02-79EV10259.

Laboratory and field data indicate that Cloeon triangulifer McDunnough has at least three generations per year in White Clay Creek (Pennslyvania). The duration of the egg stage ranged from 5 days at 30°C to about 90 days at 10°C. Larvae completed development (i.e., first instar to adult) in 27 days at 25°C, 45 days at 20°C, and 179 days at 10°C on an algal diet dominated by diatoms. Larvae reared on hickory leaves completed development in 30 days at 25°C but died prior to metamorphosis at 10, 15 and 20°C. Adult size (i.e. body length, wing length and dry mass) and fecundity were inversely related to rearing temperature for all laboratory and field experiments. The significant interaction of food quality and temperature suggest that these factors may be important in understanding geographic variation in the life history of C. triangulifer. 25 references, 3 figures, 3 tables.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 23417, 23510, 23511, 23713, 24144, 24295

24320 **(IVL-B—745) Nitrogen - a problem of water conservation. Environmental effects, emission, purification methods, costs.** Haglund, K.; Norrman, J. (Swedish Environmental Research Inst., Stockholm). Feb 1984. 110p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85751457.

The nitrogen cycle, particularly nitrification and denitrification is described. The emission of nitrogen in Sweden emanates from industry, municipal waste water, fertilization of forests and farming grounds. Nitrogen from air is distributed via precipitation. Eutrophication and health hazards are discussed. Purification processes, such as chlorination, ion exchange, ammonia elimination and reverse osmosis as well as biological processes for minor nitrogen contents in waste water are described. Comparative evaluations of various methods are made. Recommendations of preventive measures are discussed. Above 100 references.

24321 **(ORNL/TM—9317) Loves Creek anaerobic, upflow (ANFLOW) pilot plant: performance summary.** Harris, M.T.; Donaldson, T.L.; Genung, R.K.; Rivera, A.L.; Hancher, C.W. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 112p. (EPA—600/2-85/040). NTIS, PC A06/MF A01; GPO Dep. File Number DE85010578.

Anaerobic filter technology for municipal wastewater treatment has been studied in Knoxville, Tennessee with a 190-m^3/d facility from August 1981 to October 1983. The ORNL project (described by the acronym ANFLOW for the anaerobic, upflow characteristics of the technology) received funding from both DOE and EPA. During treatment of low-strength municipal wastewater before primary sedimentation, the effluent met the EPA secondary treatment discharge limits of 30 mg/L for TSS and BOD the vast majority of the time, with only an occasional increase to the 30 to 40 mg/L range for periods of 1 to 2 d. Loading rates used in this study were ~0.25 kg/m^3.d for both TSS and BOD; the hydraulic

retention time ranged from 9 to 10 h. TSS and BOD removal efficiencies were 80% and 70% respectively. This performance was maintained in ambient cold weather tests (~12°C water temperature). Approximately 20% of the influent carbon was converted to methane. Gas production increased at higher loading rates with higher strength wastewaters. The average rate of accumulation of dry solids in the bioreactor was ~150 kg/3800 m^3 (3800 m^3 = 1 million gal) of wastewater treated, which represents a 75 to 80% reduction in solids production compared to primary sedimentation and activated sludge or trickling filtration. The rate was slightly higher in cold weather and somewhat lower in warm weather. A simple material balance model was shown to predict the sludge accumulation using measurable influent and effluent parameters. 26 refs., 31 figs., 10 tabs.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 23552, 23578, 23582, 24305, 24316, 24404

24322 (NIRS-M—42, pp 57-73) **Concentration of tritium in precipitation and river water.** Chatani, Kunio (Aichi Prefectural Inst. of Public Health, Nagoya (Japan)). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

The concentration of tritium in precipitation and river water has been measured since 1973 in Aichi, Japan. The tritium in water samples was enriched by electrolysis, and measured by liquid scintillation counting. The concentration of tritium in precipitation decreased from 27 TU in 1973 to 17 TU in 1979, and showed seasonal variation. During this period, there was a rise of concentration because of Chinese nuclear detonation. The concentration of tritium in river water gradually decreased from 44 TU in 1973 to 24 TU in 1979, and the seasonal variation was not observed. Based on the observed values, the relation among precipitation, river water and ground water was analyzed.

24323 (NIRS-M—42, pp 74-84) **Concentration of tritium in surface water in Japan.** Tanaka, Kiriko (National Inst. of Radiological Sciences, Chiba (Japan)). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

The concentration of tritium in surface water in Japan has been measured since 1971. It gradually decreased from 200-400 pCi/1 in 1971 to 60-100 pCi/1 in 1979. If this decrease was assumed to be exponential, then the average half life of 5 years was estimated for the tritium in Japanese surface water during the observed period 1971-1979. From the observed values, it was also estimated that the underground residence time of ground water in the same area was 5 years according to the Brown model, which explained that the variation of concentration of tritium in surface water has been related to the input of tritium from precipitation to rivers.

24324 (NIRS-M—42, pp 129-140) **Behaviors of tritium in the aquatic biological system.** Komatsu, Kenji (Tohoku Univ., Sendai (Japan). School of Medicine). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

Behaviors of tissue-bound tritium among aquatic organisms and in their body were described. Examination of the incorporation of bound ^3H by the food chain models (predator food chain and saprophagous food chain) revealed that the maximum incorporation was increased in the killfish from the former chain and E. coli from the latter chain, compared with that in rearing with HTO alone, but no biological concentration was observed. With respect to the in vivo distribution of bound ^3H, no prominent difference was noted between the maximum incorporation into each organ and that into the whole body of HTO-reared killfish. The food chains and DNA level showed similar results. However, this uniformity was observed at equilibrium of ^3H. The biological half-life showed a diphasic pattern consisting of short and long periods. The values of short half-life were almost constant among the organisms and organs, but the long half-life differed depending on these factors, being larger in the food chains, particularly the higher animal. In the natural environment, biological concentration by the food chain was not noted either by computation using models, or by field measurements. It was not thought that the exposure dose of bound ^3H in marine products was greatly associated with the estimation of environmental dose.

24325 (NIRS-M—42) **Proceedings of the 9th National Inst. of Radiological Sciences environmental seminar on study of tritium behavior in environment and human body.** (National Inst. of Radiological Sciences, Chiba (Japan)). 1983. 288p. (In Japanese). (CONF-8112113—). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802.

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

Separate abstracts were included for each paper. (MOW)

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 23837

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 23536, 23566, 23570, 23571

24326 (PNL—5359) **Statistical considerations for evaluating survival of migrating salmonids in the Columbia River system: summary report from the ad hoc Statistical Committee to the Water Budget Center.** McKenzie, D.; Calvin, L.; Junge, C.; Ossiander, F.; McConnaha, W. (Pacific Northwest Labs., Richland, WA (USA)). Mar 1985. Contract AC06-76RL01830. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85009986.

Feasible experimental approaches and designs are developed for the estimation of annual smolt survival rates in some sections of the Columbia River Basin. Key assumptions that need to be evaluated are degree of mixing of marked groups and constancy to recovery effort. Two approaches to establishing control groups are identified and the criteria for evaluation identified. One approach to estimating survival rates includes the requirement for an accurate estimate of the collection efficiency at the recovery site. Estimation of the survival rate in the Snake River system does not appear to be feasible because of the current transportation activities. Accurate estimates of the number of marked fish transported at Lower Granite and Little Goose Dams does not currently appear feasibile. In addition, these removals reduce the number available for recovery at McNary Dam and further reduce our ability to estimate survival rates. Estimation of survival rates in this section of the system requires better estimates of transportation and higher recovery rates at McNary Dam. The direct quantitative estimation of the effectiveness of the Water Budget flows does not appear to be currently feasible because of our inability to experimentally control the important factors. Evaluation of the Water Budget flows must therefore be based on an accumulation of related information and considerable scientific judgement and interpretation. A modeling effort is suggested to aid in the understanding of the smolt survival rates and hypotheses concerning the relevant factors. 6 refs., 3 tabs.

24327 (SNV-PM—1815) **Planning of water resources. Final report from the Svartaa - project.** Haeggstroem, S. (ed.). (Statens Natuurvaardsverk, Solna (Sweden)). Apr 1984. 111p. (In Swedish). NTIS (US Sales Only), PC A06/MF A01. File Number DE85751445.

The water use in Swedish river basins is genrally multiple and conflicts sometimes occur between municipal users, farmers, industry, recreation, etc. There is a marked need for comprehensive analysis of where and when conflicts may arise and which measures could be taken to solve these conflicts. A multi-disciplinary re-

search project has chose the river Svartaa in central Sweden for the development and application of ideas and methods for regional water resources planning. Although the basin crosses several administrative borders, the research project has considered the drainage area as the natural planning region. The project has a systems approach and several methods for analysis and planning have been developed and applied. The simulation model SLUMOD is developed for general analysis of land and water use and of the consequences of different strategies for regional economic development as well as for environmental protection of the water resources. The impacts of such strategies are modelled. The results concern mainly water quality at several critical points and at different seasons. Another simulation model, MITSIM, has been applied for a more detailed quantitative analysis of the water resources: for instance water flow, reservoir storage and reliability of water withdrawals for different policies of reservoir regulations. The results are evaluated statistically. The project has developed a method for comparing the costs - at farm and at regional level - of reducing nitrogen leaching from arable land as a result of different farm practices. Also the relevance of different methods for evaluating sites for outdoor recreation are discussed with respect to the need for practical planning tools. The legal aspects of WRP in Sweden are analysed in a subproject. The many different laws concerning water use are each applicable to certain sectors of the society, and the interconnections between them are difficult to discern.

5206 Regulations

REFER ALSO TO CITATION(S) 24327

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 23541

5303 Environmental Impact Statements

24328 **(NUREG—1074-Final) Final Environmental Statement related to the operation of Hope Creek Generating Station (Docket No. 50-354).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Dec 1984. 276p. NTIS, PC A13/MF A01 - GPO $7.00. File Number TI85900429.

This Final Environmental Statement contains the second assessment of the environmental impact associated with the operation of the Hope Creek Generating Station pursuant to the National Environmental Policy Act of 1969 (NEPA) and Title 10 of the Code of Federal Regulations, Part 51, as amended, of the Nuclear Regulatory Commission regulations. This statement examines the environmental impacts, environmental consequences and mitigating actions, and environmental and economic benefits and costs associated with station operation. Land use and terrestrial and aquatic ecological impacts will be small. No operational impacts to historic and archeological sites are anticipated. The effects of routine operations, energy transmission, and periodic maintenance of rights-of-way and transmission facilities should not jeopardize any populations of endangered or threatened species. No signifcant impacts are anticipated from normal operational releases of radioactivity. The risk of radiation exposure associated with accidental release of radioactivity is very low. Socioeconomic impacts of the project are anticipated to be minimal. The action called for is the issuance of an operating license for Hope Creek Generating Station. 85 references, 28 figures, 34 tables.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

24329 **Cancer and other human diseases: DOE research programs. Hearings before the Subcommittee on Natural Resources, Agriculture Research and Environment of the Committee on Science and Technology, US House of Representatives, Ninety-Eight Congress, Second Session, March 6, 13, 1984.** Washington, DC; Government Printing Office (1984). 283p.

Doctors from several medical research institutions and laboratories testified at a two-day hearing to consider the fiscal year 1985 budget for cancer research. The budget request of $52.4 million is less than a cost-of-living increase, and will result in the closing of some laboratories and the decline in information about cancer-causing substances. The doctors described their research goals and the impact that the reduced funding will have on public health. A representative of DOE defended the administration budget, and pointed to an increase in the nuclear safety area. He also briefed the committee on the cobalt 60 incident in Mexico and other emergency and monitoring activities. Two appendices with questions and answers and additional statements submitted for the record follow the testimony of eight witnesses.

5501 Behavioral Biology

24330 **(ORAU—241) Evaluation of nonworker residents as a comparison group in occupational studies of Oak Ridge workers.** Flanders, W.D.; Cragle, D.L.; McClanahan, J.W. (Oak Ridge Associated Universities, Inc., TN (USA)). Feb 1985. Contract AC05-76OR00033. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009955.

Residents of a thirteen-county region surrounding Oak Ridge, Tennessee, have been evaluated as a comparison group for studies of possible health effects associated with employment at three Oak Ridge facilities. Several problems constitute a case against their use as a comparison group. First, a substantial amount of time and effort would be required to gather the information necessary to use as a comparison group. Second, bias may result from an inability to extrapolate census data accurately. Finally, Oak Ridge workers and other residents probably have different socioeconomic statuses and possibly different social, cultural, and ethnic backgrounds so that confounding is likely. 6 refs., 7 tabs.

5502 Biochemistry

REFER ALSO TO CITATION(S) 24392, 24393, 24401, 24408, 24416, 24436, 24437, 24438, 24439, 24440

24331 **Sensitive SV40 viral probe assay for DNA strand breaks and their biological repair in higher cells: techniques and preliminary results.** Krisch, R.E.; Tan, P.M.; Flick, M.B. (Univ. of Pennsylvania School of Medicine, Philadelphia). *Radiation Research;* **101**: No. 2, 356-372(Feb 1985). Contract AC02-83ER60163.

An alternative experimental approach to the investigation of intracellular repair of DNA strand breaks by mammalian higher cells has been developed using simian virus 40 (SV40), which has no known intrinsic DNA repair capacity and possesses a minichromosome structure, as an intracellular probe. In this approach unirradiated simian or human cells are infected with irradiated virus and incubated for varying periods. This assay involves separation of the viral DNA by agarose gel electrophoresis into three sharply demarcated bands corresponding to DNA molecules containing a double-strand break (DSB), single-strand breaks (SSB), or no breaks. Quantitative data are obtained by a combination of DNA hybridization with ^{32}P-labeled SV40 DNA, autoradiography, and densitometry. These experiments indicate that there is rapid and efficient cellular uptake of SV40, independent of prior radiation dose to the virus, and that this multistep experimental procedure gives excellent recovery and quantitation of the three DNA forms when compared with more direct methods of measurement. Initial time-course incubation experiments with SV40 infected CV-1 monkey

kidney cells indicate that this approach can demonstrate slow but extensive intracellular repair of SSB; and limited presumptive early repair of DSB, followed by later and more extensive induction of DSB.

24332 **Hydroxymethyluracil DNA glycosylase in mammalian cells.** Hollstein, M.C.; Brooks, P.; Linn, S.; Ames, B.N. (Univ. of California, Berkeley). *Proceedings of the National Academy of Sciences of the United States of America;* 81: No. 13, 4003-4007(Jul 1984).

An activity has been purified 350-fold from extracts of mouse plasmacytoma cells that forms 5-hydroxymethyluracil (α-hydroxythymine) and apyrimidinic sites with phage SPO1 DNA, which contains this base in place of thymine. This DNA glycosylase presumably functions to eliminate hydroxymethyluracil, a major thymine-derived DNA lesion produced by ionizing radiation and oxidative damage. The enzyme has no cofactor requirement and is active in EDTA. Neither intermediate formation nor hydrolysis of hydroxymethyldeoxyuridine or hydroxymethyldeoxyuridine monophosphate was detected. The enzyme does not cleave apyrimidinic sites in DNA. It does release uracil from the uracil-containing DNA of phage PBS2, but this acitivity is less than 2% of the predominant uracil DNA glycosytase activity of the cell, which is separated by phosphocellulose chromatography. The major uracil DNA glycosylase does not release hydroxymethyluracil from SPO1 DNA. The hydroxymethyluracil glycosylase is also separated upon phosphocelluose chromatography from a thymine glycol DNA glycosylase activity that is accompanied by an apyrimidinic endonuclease activity. 33 references, 2 figures, 2 tables.

24333 **Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA.** Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). 567p. (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). Cold Spring Harbor Laboratory, Box 100, Cold Spring Harbor, NY 11724. File Number TI83015606. Contract FG02-82ER60098.

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

The proceedings for the 47th Annual Cold Spring Harbor Symposia on Quantitative Biology are presented. This symposium focused on the Structure of DNA. Topics presented covered research in the handedness of DNA, conformational analysis, chemically modified DNA, chemical synthesis of DNA, DNA-protein interactions, DNA within nucleosomes, DNA methylation, DNA replication, gyrases and topoisomerases, recombining and mutating DNA, transcription of DNA and its regulation, the organization of genes along DNA, repetitive DNA and pseudogenes, and origins of replication, centromeres, and teleomeres.

24334 **Right-handed and left-handed DNA: conformational information in genetic material.** Rich, A. (Massachusetts Inst. of Tech., Cambridge). pp 1-12 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

A discussion of the chemical and biological properties of Z-DNA, a left-handed conformer of DNA. Z-DNA exists in conformational equilibrium with B-DNA, the right-handed conformer with the nucleotide sequence affecting to considerable extent the equilibrium. Use of anti-Z-DNA antibodies in immunofluorescence studies produced evidence for the existance of Z-DNA in the Drosophila chromosome, in plant chromosomes, and in protozoan chromosomes. Z-DNA is stabilized in biological systems by methylation, by cations, by proteins, and by negative supercoiling. It is suggested that Z-DNA may function in transcription by a control region having a Z conformation when suppressed or by Z-DNA affecting the level of negative supercoiling in distant DNA. 25 references, 11 figures.

24335 **Helix geometry and hydration in A-DNA, B-DNA, and Z-DNA.** Dickerson, R.E.; Drew, H.R.; Conner, B.N.; Kopka, M.L.; Pjura, P.E. (Univ. of California, Los Angeles). pp 13-24 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

The three families of DNA, A, B, and Z, are compared and contrasted in Table 2, using as prototypes the structures of CCGG, CGCGAATTCGCG and its 9-bromo derivative, and high-salt CGCG. These three molecules are displayed in Figure 1 in a way that illustrates the continuous helices that can be derived from them. The most striking contrast between families, aside from the left-handedness of Z-DNA, is the difference in overall proportions: For the same number of base-pair steps, A-DNA is short and thick, B-DNA is longer and slimmer, and Z-DNA is elongated and quite thin. This arises from a combination of tilt of base pairs to the helix axis and the positioning of that axis relative to the individual base pairs (or rather, to the Cl' atoms that connect bases to the sugar-phosphate backbone. 26 references, 10 figures.

24336 **Structural diversity in DNA: from monomer structures to oligonucleotides.** Viswamitra, M.A. (Indian Inst. of Science, Bangalore). pp 25-31 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

Structures of DNA monomers, deoxyctytidine 5'-monophosphate, deoxyadenosine 5'-monophosphate, and deoxyuridine 5'-monophosphate, are presented. These monomers show several confirmational features not common to ribonuclides. In addition, the structure of the tetranucleotide d(pATAT) and the octamer d(GGTATACC) are presented. The main features of these structures are reviewed. 44 references, 8 figures. (MF)

24337 **Right-handed and left-handed double-helical DNA: structural studies.** Wang, A.H.J.; Fujii, S.; Van Boom, J.H.; Rich, A. (Massachusetts Inst. of Tech., Cambridge; Gorlaeus Labs., Leiden, The Netherlands). pp 33-44 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

Recent structural studies on right- and left-handed fragments of DNA have considerably broadened our perspective about the conformational vitality of DNA. The high prevalence of A-DNA structures existing in crystalline lattices suggests that these structures may also exist in biological systems and may be stabilized by particular sequences or by interactions with proteins. In the same way, the discovery of Z-DNA in a crystal structure has led to its discovery in biological systems. We now have an entirely different image of DNA than was available a few years ago. The molecule may now be appropriately regarded as one that is in dynamic equilibrium among a number of different conformations. The detailed conformation assumed by the molecule is one that will be influenced by nucleotide sequence, ions in the surrounding medium, the particular proteins that bind to the molecule, and the degree of negative supercoiling stress that the molecule feels. All of these factors will be important in defining a highly dynamic system in which a number of different conformations are found. 31 references, 11 figures, 1 table.

24338 **Left-handed DNA duplexes.** Sasisekharan, V. (Indian Inst. of Science, Bangalore). pp 45-52 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

The developments that led to the proposal of left-handed duplexes for various forms of DNA are outlined. Factors discussed include: flexibility of the nucleotide unit (model building studies), helical and nonhelical domains, features of the duplexes of the domains, left-handed helices with mononucleotides as the repeating units (B and A forms of DNA), sequence specific molecular conformation of left-handed helices with dinucleotides as the repeating units, reversal of handedness in DNA and implications of the stereochemical criteria to medium-resolution, single crystal structure analysis. 26 references, 6 figures, 3 tables. (MF)

24339 **DNA secondary structures: helices, wrinkles, and junctions.** Arnott, S.; Chandrasekaran, R.; Hall, I.H.; Puigjaner, L.C.; Walker, J.K.; Wang, M. (Purdue Univ., Lafayette, IN). pp 53-65 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

X-ray diffraction patterns of threads of DNA were used to address secondary DNA structures. An attempt was made to prepare duplex junctions of the type [Bp(T/sub i/Z].[B'p(T/sub i/p)/sub n/Z'] where B.B' would be base-paired nucleosides in exactly the B-DNA conformation so that regular B-DNA helix might be continued from them. Similarly, the base-paired nucleosides Z.Z' would permit a standard Z-DNA helix to be continued from them. It was not possible to construct junctions with i = 0 but it was possible with i = 1. Therefore, only 2 stacks of base pairs need be different from the orthodox B or Z to affect a B → Z transition in an intact duplex. The question of whether the B form of poly[d-(GC)] . poly[d(GC)] has detectable conformational features on its backbone that would presage the distinctive sequence in its interior involves determining whether a 10_1 helix of repeating mononucleotides is an adequate model for this structure or whether a 5_1 helix provides a superior model. The best least squares 10_1 model has a very high crystallographic residual and is difficult to pack into the unit cell, while the best 5_1 model packs easily but has a low R. The chirality of calf thymus B-DNA (B form poly[d(GC)] . poly[d(GC)] and D form poly[d(IC)] . poly[d(IC)] was reviewed. Results indicate that: 10_1 and 10_4 models are not significantly different; right-handed 5_1 model is preferred to the left-handed 5_4 model; the right-handed 4_1 polynucleotide model is superior to the left-handed 4_3 model; and the 8_1 and 8_7 models cannot be distinguished. 32 references, 9 figures, 3 tables.

24340 **DNA structures and transitions: x-ray diffraction studies of solvated fibers.** Zimmerman, S.B.; Pheiffer, B.H. (National Institutes of Health, Bethesda, MD). pp 67-76 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). DE84015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

When concentrated solutions of DNA are dried into fibers, there is a tendency for the molecules to become oriented with their molecular axes aligned in the direction of the fiber axis. Conformations studied (by x-ray diffraction) of such fibers are based on solid-phase samples in which the molecular conformation may be significantly affected by packing forces. A procedure for using wet samples to avoid these problems was used. In the samples, good molecular orientation was retained for at least several weeks. Such stability raises the possibility of using diffraction methods in kinetic studies of the interactions of polymers with solvents or low-molecular weight solutes. The results described are based on classic diffraction techniques that were applied to samples under conditions that approach those in free solution. 54 references, 7 figures, 3 tables. (MF)

24341 **Left-handed DNA helices, supercoiling, and the B-Z junction.** Wells, R.D.; Brennan, R.; Chapman, K.A.; Goodman, T.C.; Hart, P.A.; Hillen, W.; Kellogg, D.R.; Kilpatrick, M.W.; Klein, R.D.; Klysik, J. (Univ. of Wisconsin, Madison; Univ. of Alabama, Birmingham; Georgia Institute of Technology, Atlanta). pp 77-84 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

A family of recombinant DNA's containing the dc-dg tract were constructed to evaluate the replication and recombination properties in vivo. The results allowed an evaluation of the junction between a right-handed and a left-handed segment. In addition, the influence of DNA supercoiling on the right-handed to left-handed structural transition was investigated. 24 references, 9 figures, 1 table. (MF)

24342 **DNA supercoiling and its effects on DNA structure and function.** Wang, J.C.; Peck, L.J.; Becherer, K. (Harvard Univ., Cambridge, MA). pp 85-92 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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A discussion of the quantitative aspects of DNA supercoiling and its effects on structural transitions, such as the flipping of a right-handed helical segment to a left-handed one or the formation of a pair of hairpinned structures (a cruciform) from a palindromic sequence, is presented. In addition, some preliminary studies on the regulation of DNA supercoiling in the bacterium, Escherichia coli, are discussed. 37 references, 2 figures, 1 table.

24343 **Supercoiling and left-handed Z-DNA.** Nordheim, A.; Peck, L.J.; Lafer, E.M.; Stollar, B.D.; Wang, J.C.; Rich, A. (Massachusetts Inst. of Tech., Cambridge; Harvard Univ., Cambridge, MA; Tufts Univ. School of Medicine, Boston, MA). pp 93-100 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). DE84015606

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Investigations of supercoiling in left-handed Z-DNA were conducted. The results show that negatively supercoiled plasmids in the physiological range of negative superhelical densities can convert segments into Z-DNA. Negative superhelical DNA is not confined to covalently closed circles of DNA, but it is believed that the chromosomes in prokaryotic cells as well as eukaryotic cells are found in domains of DNA with local topological constraints. These experiments on supercoiling and Z-DNA formation may also have some relevance to an understanding of the more complex systems in eukaryotic genomes in which DNA is organized into nucleosomes and higher-order structures. 24 references, 7 figures.

24344 **Dynamic, sequence-dependent DNA structure as exemplified by cruciform extrusion from inverted repeats in negatively supercoiled DNA.** Lilley, D.M.J. (Univ. of Dundee, Scotland). pp 101-112 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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There is now strong evidence supporting the existence of cruciform structures extruded from inverted repeat sequences in negatively supercoiled DNA. These sequences become centrally hypersensitive to single-strand-specific nucleases in a manner that is totally dependent on the torsional stress and with a cleavage distri-

bution in close agreement with that predicted for a hairpin-loop geometry. Experiments designed to measure the lifetimes of such cruciforms indicate that the structures are transient, in a dynamic equilibrium with regular duplex. The lifetimes are therefore determined by the Boltzmann population as related to the free energy of the structure. Topological considerations indicate that the stem length of the cruciform will most significantly increase the lifetime of the cruciform. However, cruciforms with longer stem lengths appear to be genetically unstable for a variety of potential reasons. 54 references, 10 figures, 1 table.

24345 **Salt-induced transition between two double-helical forms of oligo(dC-dG).** Pohl, F.M. (Univ. Konstanz, West Germany). pp 113-117 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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The change between a right-handed and a left-handed double-helical structure is an extreme example of the conformational variability of DNA. Studying the energetics and dynamics with defined oligomers provides a convenient way to obtain a quantitative understanding of such processes and can serve as a model for possible regulatory mechanisms in biological systems. Monoclonal antibodies with different specificities to Z-DNA offer a promising technique to search for such structures in more-complicated systems and represent a model system for the quantitative investigation of the interaction of proteins with particular conformations of DNA.

24346 **DNA formed by reassociation of complementary single-stranded circles from natural DNA is shown to contain left- and right-handed double helices.** Brahms, S.; Vergne, J.; Brahms, J.G.; Di Capua, E.; Bucher, P. (Paris-7 Univ., France; Institut fuer Zellbiologie, Zurich, Switzerland). pp 119-124 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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The conformation of form-V DNA, obtained by reassociation of complementarity, was used to investigate whether DNA with natural base sequences will form a stable left-handed double helical conformation under conditions of low salt concentration (close to physiological). Results show that by application of a topological constraint, DNA with natural base sequence can adopt a left-handed helical conformation at low ionic strength (not only involving d[G-C] sequences), which coexists with right-handed B-type helices and negative superhelical turns. This may have functional implications and may be of importance for understanding regulation of gene expression. 21 references, 4 figures, 2 tables.

24347 **Transitions induced by metal complexes among several forms of DNA.** Eichhorn, G.L.; Shin, Y.A.; Butzow, J.J. (Department of Health and Human Services, Baltimore, MD). pp 125-127 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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B-DNA, Z-DNA, and psi-DNA, as well as another DNA conformer, are shown to be readily interconvertible in the presence of cobalt complex ($[Co(NH_3)_6]Cl_3$). We believe that these transformations of unaggregated and aggregated DNA conformers are of considerable interest in terms of the conformational flexibility of DNA molecules. Such flexibility may be important in the action of DNA templates in RNA synthesis. We have found that $[Co(NH_3)_6]Cl_3$ activates Escherichia coli RNA polymerase in the presence of a poly(dA-dT).poly(dA-dT) template, which cannot exist in the Z form, but inhibits when the template is poly(dG-dC).poly(dG-dC), and we attribute this difference in part, to the conformational difference in the templates. 15 references, 2 figures.

24348 **Alternative description of the transition between B-DNA and Z-DNA.** Hopkins, R.C. (Univ. of California, Los Angeles). pp 129-131 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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An alternate mechanism is proposed for the transition of B-DNA to Z-DNA. Since the Z-DNA structure is intermediate to regular forms II(L) and II(R), it is possible that both DNA forms in the transition have chain configuration II, one being the irregular Z-type the other the regular II(L) or II(R), rather than the canonical B-DNA structure. Transition between these forms would involve a twisting motion about the helical axis, accompanied by unstacking of 2 or more base pairs and a concomitant sugar reorientation about the glycosyl bond; no pairing or flipping of bases would be required. If the forms have the same handedness there would be little steric hinderance to rotation between anti and syn conformations. Alternatively opposite handedness would be sterically hindered. 26 references, 1 figure.

24349 **Electron microscopy of Z-DNA.** Castleman, H.; Erlanger, B.F. (Columbia Univ., New York, NY). pp 133-142 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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These studies examine poly(dG-dC) and various derivatives of it by electron microscopy under conditions in which they were reported to be in the Z conformation. The electron microscopy studies show, except for brominated poly(dG-dC) and poly(dG-dC) in the presence of $MnCl_2$, that the transition to the Z conformation, as determined by inversion of the CD spectrum, can be accompanied by extensive self-association (i.e., condensation). This association may be responsible for two observations reported by others, namely, that the half-time of proton exchange of poly(dG-dC) in high salt is 50 times greater than that under conditions of low salt concentration and that extensive substitution of poly(dG-dC) by AAF is not possible at high salt concentrations. 33 references, 5 figures.

24350 **Generation of left-handed Z-DNA in solution and visualization in polytene chromosomes by immunofluorescence.** Jovin, T.M.; Van De Sande, J.H.; Zarling, D.A.; Arndt-Jovin, D.J.; Eckstein, F.; Fueldner, H.H.; Greider, C.; Grieger, I.; Hamori, E.; Kalisch, B. (Max-Planck-Inst. fuer Biophysikalische Chemie, Goettingen, Germany; Univ. of Calgary, Alberta; Max-Planck-Inst. fuer Experimentelle Medizin, Goettingen, Germany; Tulane Univ., New Orleans, LA). pp 143-154 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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Our experiments to date demonstrate the ubiquitous localization of Z-DNA within highly condensed regions of polytene chromosomes, both in the fixed and unfixed state. An interpretation of this finding requires consideration of the following points: (1) the amount of bound antibody has yet to be quantitated and an evaluation has yet to be made as to how the observed staining intensity may reflect differences in accessibility of the first and/or second antibodies as well as true variations in the local density of Z-DNA. (2) It cannot be excluded that some anti-Z-DNA antibodies with high affinity induce the formation of the Z conformation in (some) chromosomal regions where it may otherwise not preexist. 50 references, 10 figures, 2 tables.

24351 Antibody recognition of Z-DNA. Lafer, E.M.; Moeller, A.; Valle, R.P.C.; Nordheim, V.A.; Rich, A.; Stollar, B.D. (Tufts Univ. School of Medicine, Boston, MA; Massachusetts Inst. of Tech., Cambridge). pp 155-162 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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To measure serological reactions under physiological ionic strength, we prepared a brominated (Bl) poly(dG-dC).poly(dG-dC), which forms a stable Z helix in solutions of low salt concentration. Mice and rabbits were immunized with this polymer complexed with the basic protein methylated bovine serum albumin (MBSA), and it was discovered that the Z-DNA helix is a strong immunogen. Various antibody populations were purified from the rabbit serum by quantitative immunoprecipitation. Spleen cells from the mice were used for the preparation of hybridoma cell lines secreting monoclonal antibodies. Anti-Z-DNA antibodies were also raised by immunizing animals with poly(dG-dm^{5}C).poly(dG-dm^{5}C) under conditions where it was reported to be in the left-handed Z conformation as well as unmodified poly(dG-dC).poly(dG-dC) that was in the right-handed B conformation: both were complexed with MBSA. Z-DNA reactive antibodies were found in both murine and human SLE. A Z-DNA-specific as well as a dDNA and Z-DNA cross-reactive antibody population were distinguished by affinity chromatography of the SLE sera. The specificities of the various anti-Z-DNA antibody populations were measured by direct-binding and competitive radioimmunoassays, using synthetic polymers of defined structure under various ionic strengths. These studies allow us to map the possible antigenic sites for these antibodies, which serve as a model for DNA-protein recognition. The findings also established the usefulness of the antibodies as biochemical probes for Z-DNA. 29 references, 6 figures, 1 table.

24352 Interactions between nucleic acids and antibodies to Z-DNA. Leng, M.; Hartmann, B.; Malfoy, B.; Pilet, J.; Ramstein, J.; Sage, E. (Centre National de la Recherche Scientifique, Orleans, France). pp 163-170 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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In this paper we report some properties of the antibodies to Z-DNA. To determine more precisely the antigenic determinant, the interactions between the antibodies and several polynucleotides have been studied. We found that the antibodies bind very weakly to poly(dI-br^{5}dC).(dI-br^{5}dC). This polynucleotide can adopt the Z conformation in high salt concentration, as we have demonstrated by infrared spectroscopy. Moreover, from the study of the exchange rate of the protons involved in hydrogen bonds in this polynucleotide and from previous studies on poly(dG-dC).poly(dG-dC) (Ramstein and Leng 1980; Pilet and Leng 1982), we propose a quantitative description of the dynamic structure of the Z form. 34 references, 5 figures, 3 tables.

24353 Dynamic behaviors of DNA molecules in solution studied by fluorescence microscopy. Yanagida, M.; Hiraoka, Y.; Katsura, I. (Kyoto Univ., Japan; Univ. of Tokyo, Japan). pp 177-187 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY ; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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Detailed and quantitative studies on the dynamic behavior of DNA molecules in solution were done. Results showed that DNA conformation in solution is a folded structure that fluctuates rapidly in the absence of external force. Thick and thin filaments formed by external forces exhibited a characteristic behavior in solution. The folded structures appear to be stabilized by coils and domains. Results are discussed in relation to preexisting physicochemical data and theories. 14 references, 9 figures, 2 tables.

24354 New techniques for purifying large DNAs and studying their properties and packaging. Schwartz, D.C.; Saffran, W.; Welsh, J.; Haas, R.; Goldenberg, M.; Cantor, C.R. (Columbia Univ., New York, NY). pp 189-195 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY ; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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A series of different cross-linking strategies have been developed that allow direct information about DNA packaging to be obtained. These techniques allow examination of DNA and protein proximity relationships in complex nucleoprotein assemblies. A new type of electrophoresis has been developed that permits purification and analysis of relatively large, unbroken pieces of double-stranded DNA. This technique promises to assist studies of gene structure and organization. It also may provide a new way of examining factors that modulate the flexibility of DNA. 18 references, 9 figures.

24355 NMR studies of DNA conformation and dynamics in solution. Patel, D.J.; Kozlowski, S.A.; Ikuta, S.; Itakura, K.; Bhatt, R.; Hare, D.R. (Bell Labs., Murray Hill, NJ; City of Hope National Medical Cener, Duarte, CA; Hoffmann-LaRoche, Inc., Nutley, NJ; Univ. of Washington, Seattle). pp 197-206 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY ; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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Recent NMR investigations of the conformation and dynamics of the fully alternating d(CGCGTATACGCG) duplex in aqueous solution are summarized. The observation of intra- and inter-base-pair NOEs permitted the assignment of exchangeable and non-exchangeable proton markers at individual base pairs. The proton resonances monitor a noncooperative premelting transition localized in the TATA center of the duplex. This transition appears to be a common feature of dA.dT-rich regions and reflects structural variations that perturb the base-pair overlaps in the duplex state. The partially resolved phosphorus NMR markers of the TATA 12-mer duplex monitor another premelting transition that reflects the onset of loop formation prior to the helix-coil transition. The dynamics of the TATA 12-mer duplex have been probed by monitoring hydrogen-exchange kinetics of the individually resolved and assigned imino protons. The hydrogen exchange rates derived from the saturation-recovery experiments are a measure of the transient opening of single base pairs in the duplex. The opening kinetics for the central dA.dT base pairs are much faster than the corresponding values for the flanking dG.dC base pairs. We observe a sequence dependence in the exchange rates at dA.dT base pairs, as reflected in the much faster opening kinetics for the alternating TATA 12-mer duplex than for the nonalternating duplex. The NMR spectra readily monitor and characterize a structural equilibrium between a fully paired TATA 12-mer duplex and a loop conformation involving the TATA segment in a turn stabilized by a dG.dC base-pair stem region. The equilibrium shifts to the loop structure on lowering the DNA and counterion concentration, as well as raising the temperature, whereas addition of salt reestablishes the fully paired structure. 30 references, 12 figures, 2 tables.

24356 Application of multi-pulse H-NMR techniques to the study of two synthetic DNA decamers. Feigon, J.; Wright, J.M.; Denny, W.A.; Leupin, W.; Kearns, D.R. (Univ. of California, San Diego, La Jolla; Univ. of Auckland School of Medicine, New Zealand). pp 207-217 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY ; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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NMR results obtained on 2 synthetic DNA decamers, d(ATATCGATAT)$_2$ and d(ATATGCATAT)$_2$, using a variety of multiplepulse techniques are summarized. These include selective and nonselective spin-lattice relaxation measurements, spin-spin relaxation measurements, transient nuclear Overhauser effect (NOE) experiments, and two-dimensional NOE and J-correlated spectroscopy. Information about base-pair opening rates, sugar conformations, specific interproton separations and the dynamic behavior of DNA is provided. 28 references, 8 figures.

24357 **Statistical mechanical analysis of competing conformational transitions in superhelical DNA.** Benham, C.J. (Univ. of Kentucky, Lexington). pp 219-227 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY ; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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A multistate statistical mechanical analysis of the competition between transition to an alternative helical form and cruciform extrusion in a stressed segment of DNA susceptible to both is developed. This analysis extends the two-state theory developed previously (Benham). Briefly, the states of the system are enumerated (e.g., indexed by i), and a free energy F/sub i/ is associated with each. This approach may be applied to transitions involving cruciforms and/or any helical or denatured alternative conformations; however, in this paper superhelical B → Z transitions, both alone and in competition with cruciforms are specifically analyzed. This was done primarily because of the considerable current interest in these phenomena and also because computations involving long sequences remain tractable, provided the susceptible sites are not too extensive. 15 references, 10 figures.

24358 **Theoretical probes of DNA conformation examining the B → Z conformational transition.** Olson, W.K.; Srinivasan, A.R.; Marky, N.L.; Balaji, V.N. (Rutgers-the State Univ., New Brunswick, NJ). pp 229-241 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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A theoretical search for the likely pathways linking B-DNA and Z-DNA was conducted. Various routes that preserve the stabilizing stacking and hydrogen-bonding interactions of the heterocyclic bases, focusing particular attention on the variations of the glycosyl rotation were examined. The bases interconvert between syn and anti arrangements without substantial increase in potential energy, provided one or more parallel, nonadjacent torsions in the sugar-phosphate backbone simultaneously vary in the opposite rotational sense. Moreover, if coupled with rotational changes in the acyclic bonds that immediately precede and follow them in the chain sequence, the mobile bases also maintain their parallel alignment in the helical structure and their capacity to hydrogen-bond with complementary residues in the opposite strand. In addition, the correlated glycosyl-backbone changes displace the bases in question with respect to their immediate neighbors, creating sharp U-turns in the double helix and providing topologically direct connections between B-DNA and Z-DNA. The reversals of direction, however, condense the polynucleotide structure during the right-to-left transition, the effect being more pronounced at greater chain lengths. The macroscopic dimensions at the two ends of the transition, nevertheless, approach the extremely high values typical of stiff, rod-like chains. 34 references, 10 figures, 2 tables.

24359 **Cooperative transitions in DNA with no separation of strands.** Ivanov, V.I.; Minchenkova, L.E.; Minyat, E.E.; Schyolkina, A.K. (Institute of Molecular Biology, Moscow, USSR). pp 243-250 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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The physical nature of cooperative changes within the double-stranded state of DNA, i.e., the interfamily transitions are discussed. In addition, the possible biological applications of the anti B → anti A transition are discussed. 45 references, 10 figures.

24360 **Computer simulation of DNA double-helix dynamics.** Levitt, M. (Weizmann Inst. of Science, Rehovoth, Israel). pp 251-262 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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The nature of the dynamics of the DNA double helix was investigated using the technique of molecular dynamics simulation. This technique simulates the movement of atoms in the static x-ray structure and provides information about amplitudes; frequencies of vibrations; and the type, rate, and pathway of conformational changes. Results are presented for simulations of room-temperature atomic motion of 12-bp and 24-bp DNA double helices. The hydrogen bonds between base pairs are stable and the motions of the torsion angles are of small amplitude. The length fluctuations of adjacent hydrogen bonds are weakly correlated, whereas the torsion angles show stronger correlations that agree with the static x-ray structures. Both DNA fragments show cooperative bending and twisting motions of large amplitude that do not involve major perturbations of the DNA torsion angles. This differs from that expected in that it is asymmetric, always acting to close the major groove of DNA; and it consists predominantly of a normal mode that has a wavelength close to the helical repeat length. The stack of base pairs also kinks into the minor groove. This global motion is consistent with nuclear magnetic resonance measurements and explains the observed sensitivity of DNA conformation to environment. These calculations have implications for DNA double helix with repressors, polymerases, and other cellular proteins. The marked contrast between the bending flexibility and the stability of the hydrogen-bonded base pairs suggests that DNA may protect the integrity of the genetic message by absorbing thermal perturbations in bending motions, rather than in base-pair-opening motions. 41 references, 8 figures, 3 tables.

24361 **Transmission of long-range effects in DNA.** Crothers, D.M.; Fried, M. (Yale Univ., New Haven, CT). pp 263-269 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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Our purpose is to set out general classes of long-range transduction in DNA. We note at the start, however, that our focus on long-range effects is not intended to diminish the importance of possible direct protein-protein interactions in gene regulatory systems. Subsequently, we examine recent equilibrium and kintic results on the interaction of CAP protein with Escherichia coli lac promoter DNA fragments from the perspective of their implications for long-range effects in DNA. 46 references, 7 figures, 1 table.

24362 **Sequence-dependent variations of B-DNA structure and protein-DNA recognition.** Trifonov, E.N. (Weizmann Inst. of Science, Rehovoth, Israel). pp 271-278 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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A sequence-specific protein-DNA recognition principle is described. The main features of the principle are: (1) certain physical and structural features of the DNA molecule, rather than its nucleotide sequence, are recognized; (2) recognized features are func-

tions of the elements of the nucleotide sequence (mono-, di-, or higher oligonucleotides) and are frequently the same for several alternative elements; (3) the occurrence of different elements (e.g., dinucleotides) along the recognition region, expressed in the matrix form, reflects their relative importance for recognition; (4) the most prominent elements of the matrix appear in a particular recognized sequence only as a subset, different for different sequences; the remainder of the sequence consists essentially of noise elements; (5) the similarity of the nucleotide sequence to the distribution given by the matrix can be considered a measure of the efficiency of recognition. 31 reference, 4 figures, 2 tables.

24363 **Bent helix in kinetoplast DNA.** Marini, J.C.; Levene, S.D.; Crothers, D.M.; Englund, P.T. (Johns Hopkins Univ. School of Medicine, Baltimore, MD; Yale Univ., New Haven, CT). pp 279-283 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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The structure of mitochondrial DNA in trypanosomes was studied. On the basis of its anomalous behavior in gel electrophoresis, gel filtration and electric dichroism, it was concluded that the molecule has an unusually compact conformation. This conformation is likely due to a bend which may be due to sequence periodicities. 25 references, 5 figures, 1 table.

24364 **Helical periodicity of DNA on and off the nucleosome as probed by nucleases.** Klug, A.; Lutter, L.C.; Rhodes, D. (Medical Research Council, Cambridge, England). pp 285-292 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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This paper attempts to resolve the linking-number paradox by proposing a model with a helical periodicity of 10.0 bp/turn. The model is based on earlier data in which nuclease cutting sites were located in spatial terms in three dimensions. This model with an average tenfold periodicity for the DNA accounts for the general pattern of cutting by both DNase I and DNase II on the nucleosome. For simplicity, a constant periodicity along the path of the DNA was assumed, but it might be expected that there will be local variations brought about by interactions with different patches of histones. One might also expect local deviations from the simple pattern of enzyme accessibility, arising from special features of the histone surface. For these reasons and since the exact shapes of the enzymes and their manner of binding and cutting, are not known the average helical periodicity cannot be determined precisely; however, it is much more likely to be closer to 10.0bp/turn than to 10.5 bp/turn. A value of 10.1 bp/turn is not ruled out, but 10.2 and 10.3 bp/turn become unfavorable. 41 references, 7 figures, 1 table.

24365 **β-kinked DNA: a structure that gives rise to drug intercalation and DNA breathing - and its wider significance in determining the premelting and melting behavior of DNA.** Sobell, H.M.; Sakore, T.D.; Jain, S.C.; Banerjee, A.; Bhandary, K.K.; Reddy, B.S.; Lozansky, E.D. (Univ. of Rochester, NY). pp 293-314 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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We have proposed the existence of acoustic phonons to be a manifestation of the dynamic nature of DNA structure in solution associated with the fluctuations that exists at equilibrium. When solvent molecules collide with DNA down its dyad axes, specific normal mode waves are excited, and these travel along the helix at the speed of sound. Due to constructive interference, the elastic limit of the B helix is occasionally exceeded, this gives rise to small elements of β-kinked-DNA conformational change. This structure is hyperflexible and therefore undergoes enhanced energy fluctuations during its lifetime. These fluctuations result in further base unstacking, which allows drugs and dyes to intercalate into DNA, and transient hydrogen bond breakage, which gives rise to DNA breathing. This paper summarizes our theory for DNA premelting and its implications in molecular biology.

24366 **Some new aspects of actinomycin D-nucleic acid binding.** Takusagawa, F.; Berman, H.M. (Fox Chase Cancer Center, Philadelphia, PA). pp 315-321 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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DNA is the cellular target for actinomycin D (AMD), a widely used biochemical tool (Goldberg and Friedman 1971; Kersten and Kersten 1974), with specific chemotherapeutic agent. However, its exact mode of binding is not as well understood as those of more simple molecules. The results of these studies also suggest that the conformation of the phosphodiester linkage is different from that observed in solutions of planar drug-oligomer complexes. We discovered a unique and unexpected structure that we have called pseudointercalated.

24367 **Netrospin increases the linking number of DNA.** Malcom, A.D.B.; Snounou, G. (St. Mary's Hospital Medical School, London, England). pp 323-326 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

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The antibiotic netropsin shows both antibacterial and antiviral activities. This effect is thought to be a consequence of its high affinity for double stranded DNA. This interaction was studied. Data are provided which show that binding of netropsin distorts the sugar phosphate backbone of the DNA in such a way as to increase the linking number. 18 references, 5 figures.

24368 **Sharp kink of DNA at psoralen-cross-link site deduced from crystal structure of psoralen-thymine monoadduct.** Kim, S.H.; Peckler, S.; Graves, B.; Kanne, D.; Rapoport, H.; Hearst, J.E. (Univ. of California, Berkeley). pp 361-365 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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Light-induced cross-linking of double-stranded nucleic acids by psoralens has been exploited to locate, in vivo or in vitro, those double-helical regions of DNA or RNA that can accommodate any structural changes caused by the psoralen cross-links. To determine three-dimensional structural parameters of the cross-link, we have solved the crystal structure of the psoralen-thymine monoadduct formed in photoreaction between calf thymus DNA and 8-methoxypsoralen (8MOP). There are eight possible configurations for psoralen-thymine monoadducts and 64 for diadducts. We describe here the structural details of a psoralen-thymine monoadduct obtained in a biological environment and the consequences of the photo-cross-link between 8MOP and double-helical DNA.

24369 **Synthetic sequence-specific ligands.** Gursky, G.V.; Zasedatelev, A.S.; Zhuze, A.L.; Khorlin, A.A.; Grokhovsky, S.L.; Streltsov, S.A.; Surovaya, A.N.; Nikitin, S.M.; Krylov, A.S.; Retchinsky, V.O. (Institute of Molecular Biology, Moscow, USSR). pp 367-378 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI85015606

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In this paper is summarized attempts to evaluate the interaction free energies of a distamycin A (Dst) amide group with each of the four DNA bases. It is believed that the binding principles found for Dst may show a way to the synthesis of ligands with defined sequence specificity and that these principles, in a generalized form, may describe specific protein-nucleic acid interactions. Also described in this paper is the DNA-binding properties of a series of bis-netropsins (bis-Nts) and bis-actinomycins, synthetic ligands of which each is composed of the two monomers linked by a flexible chain. Certain oligopeptides with defined amino acid sequences can bind to DNA in a sequence-specific manner. At present it seems likely that the information determining the recognition of specific DNA sequences by regulatory proteins is inherent in the primary sequence of the polypeptide chain. 41 references, 12 figures, 4 tables.

24370 **Solid-phase synthesis of polynucleotides. VIII: a simplified synthesis of oligodeoxyribonucleotides.** Tan, Z.K.; Ikuta, S.; Huang, T.; Dugaiczyk, A.; Itakura, K. (City of Hope Research Institute, Duarte, CA; Baylor College of Medicine, Houston, TX). pp 383-391 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

This paper describes the details of a simple and economical chemical method recently developed for the preparation of oligodeoxyribonucleotides. It believed that the simplicity of this method will allow molecular biologists without a chemistry background to synthesize desired oligomers using commercially available reagents and solvents. 20 references, 7 figures, 2 tables.

24371 **Continuous-flow phosphotriester method for solid-phase synthesis of oligodeoxyribonucleotides.** Gait, M.J.; Matthes, H.W.D.; Singh, M.; Sproat, B.S.; Titmas, R. (Medical Research Council Centre, Cambridge, England). pp 393-401 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

The syntheses described here introduced several significant improvements to the methodology of solid-phase oligodeoxyribonucleotide synthesis. The use of the composite polydimethylacrylamide-kieselguhr support packed in a column allows more-efficient and more rapid oligonucleotide asemblies to be carried out than by batchwise methods. Synthesis can be on a smaller scale. An inexpensive bench-top solvent delivery was designed that is simple to operate. Human errors are less likely to occur than in a totally manual procedure, yet the equipment is not costly to set up or maintain. 21 references, 7 figures, 2 tables.

24372 **Synthesis and conformational analysis of synthetic DNA fragments.** Van Boom, J.H.; Van Der Marel, G.A.; Westerink, H.; Van Boeckel, C.A.A.; Mellema, J.R.; Altona, C.; Hilbers, C.W.; Haasnoot, C.A.G.; De Bruin, S.H.; Berendsen, R.G. (Gorlaeus Laboratories, Leiden, Netherlands; Univ. of Nijmegen, Netherlands). pp 403-409 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

As part of the program to synthesize DNA fragments that will serve as probes directed toward molecular biology and biophysics, it is reported that 3'-phosphotriester 3 promises to be an attractive alternative for the other two intermediates that are presently used in the synthesis of DNA fragments via phosphotriester intermediates. 31 references, 6 figures.

24373 **Chemical synthesis and biological studies on mutated gene-control regions.** Caruthers, M.H.; Beaucage, S.L.; Efcavitch, J.W.; Fisher, E.F.; Goldman, R.A.; DeHaseth, P.L.; Mandecki, W.; Matteucci, M.D.; Rosendahl, M.S.; Stabinsky, Y (Univ. of Colorado, Boulder). pp 411-418 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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A new methodology for the rapid and efficient-synthesis of deoxyoligonucleotides of define sequence is reported. The method was designed so that investigators who were not familiar with oligonucleotide synthesis could prepare DNA sequences that are important to their research. 35 references, 5 figures, 3 tables. (DT)

24374 **Catabolite gene activator protein: structure, homology with other proteins, and cyclic AMP and DNA binding.** Steitz, T.A.; Weber, I.T.; Matthew, J.B. (Yale Univ., New Haven, CT). pp 419-426 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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The catabolite gene activator protein (CAP), also known as the cyclic AMP (cAMP) receptor protein, is an allosteric protein that functions in the positive and negative regulation of the catabolite operons, as well as many other operons in Escherichia coli. The three-dimensional structure of CAP complexed with cAMP was determined from an electron-density map with a 2.9-A resolution to which the amino acid sequence was fit. The crystals were grown under conditions in which CAP binds to DNA. Each subunit of the CAP dimer is seen to be folded into two distinct domains. The larger aminoterminal domain contains a completely buried cAMP molecule bound between the interior of a β-roll structure and a very long α helix. All of the interactions between the two subunits are provided by the larger cAMP-binding domain. The smaller carboxyterminal domain contains three α helices and a small amount of β-sheet structure. 25 references, 10 figures.

24375 **Cro repressor protein and its interaction with DNA.** Matthews, B.W.; Ohlendorf, D.H.; Anderson, W.F.; Fisher, R.G.; Takeda, Y. (Univ. of Oregon, Eugene; Univ. of Alberta, Edmonton; Univ. of Maryland, Catonsville). pp 427-433 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

The recently determined three-dimensional structure of Cro repressor protein from bacteriophage λ suggests how this DNA-binding protein recognizes its sequence-specific binding sites on the bacteriophage genome. This paper describes the presumed complex between Cro and DNA and discusses its implications for DNA-protein recognition in general. Also described are results suggesting that the structures of a number of other sequence-specific DNA-binding proteins may contain an α-helical region similar to that seen in the presumed DNA-binding region of Cro. 18 references, 7 figures.

24376 **Structure of the operator-binding domain of bacteriophage λ repressor: implications for DNA recognition and gene regulation.** Lewis, M.; Jeffrey, A.; Wang, J.; Ladner, R.; Ptashine, M.; Pabo, C.O. (Harvard Univ., Cambridge, MA). pp 435-440 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

To understand the molecular basis of gene regulation, a crystallographic study of the repressor from bacteriophage was undertaken. The λ repressor binds to two operator regions in the bacteriophage DNA, thereby preventing transcription of other bacteriophage genes while stimulating transcription of its own gene. The operator-binding domain of the repressor has been crystallized, and its structure has been determined at a 3.2-A resolution. The structure of the aminoterminal fragment and the basic model that has been proposed for the repressor-operator interaction is reviewed. Preliminary model-building studies of the specific contacts that stabilize the λ repressor-operator complex are described and some tentative conclusions about protein-DNA recognition are drawn. 25 references, 7 figures.

24377 **Mutations defining the operator-binding sites of bacteriophage λ repressor.** Nelson, H.C.M.; Hecht, M.H.; Sauer, R.T. (Massachusetts Inst. of Tech., Cambridge). pp 441-449 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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About 50 different amino acid substitutions in the aminoterminal domain of bacteriophage of λ repressor were characterized. Sixteen of these substitutions alter external side chains of the repressor and cause a substantial reduction in the affinity of the mutant repressor for operator DNA. Seven of these mutant repressors were purified and were shown to be stably folded. The strong, external repressor mutations occur near the aminoterminal end of α helix 2, throughput α helix 3, and in the aminoterminal-arm region of the repressor. These results suggest that these regions of λ repressor are close to operator DNA in the protein-DNA complex and thus that these regions comprise the DNA-binding sites of the repressor. These genetic results support and are completely consistent with more-detailed models of the repressor-operator interaction based on model-building and biochemical studies. 38 references, 2 figures, 3 tables.

24378 **Direct measurement of DNA unwinding angle in specific interaction between lac operator and repressor.** Kim, R.; Kim, S.H. (Univ. of California, Berkeley). pp 451-454 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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The affinity between DNA and protein in sequence-specific interaction often varies depending on the superhelical density of the DNA. These variations may play an important role in the regulation of the biological functions of these proteins. In general, these proteins bind slightly better to supercoiled DNA than to relaxed DNA that contains the cognate sequence. This can be interpreted as due to small unwinding of the recognized DNA upon protein binding. We report here the direct measurement of unwinding angle in the lac repressor-operator interaction using a stable plasmid constructed to contain multiple copies of the lac operator sequence. 7 references, 5 figures.

24379 **Size of the unwound region of DNA in Escherichia coli RNS polymerase and calf thymus RNA polymerase II ternary complexes.** Gamper, H.B.; Hearst, J.E. (Univ. of California, Berkeley). pp 455-461 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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This paper addresses interests in refining the structure of the RNA polymerase ternary complex so as to understand better the mechanisms of pausing and termination. The approach used was to determine the size of the DNA unwound region in Escherichia coli RNA polymerase and calf thymus RNA polymerase II (pol II) ternary complexes formed on superhelical SV40 DNA. Polymerase-induced unwinding has been quantified by relaxing the ternary complexes and electrophoresing the deproteinized DNA. Analysis shows that the unwound region is 17 +- 1 bp (580 +- 30°) long in the E. coli complex and at least 10 to 11 bp (360°) long in the calf thymus complex. The results with the bacterial enzyme allow a proposed topological model for transcription. 26 references, 9 figures.

24380 **Ion effects on the aggregation and DNA-binding reactions of Escherichia coli RNA polymerase.** Shaner, S.L.; Melancon, P.; Lee, K.S.; Burgess, R.R.; Record, M.T. Jr. (Univ. of Wisconsin, Madison). pp 463-472 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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This paper summarizes work on the direct and indirect effects of electrolyte ions on the aggregation and DNA-binding reactions of E. coli RNA polymerase: (1) recalculation of the binding constants, taking into account all the coupled equilibria affecting free-protein concentration, demonstrates the importance of such corrections; (2) the extent of RNA polymerase aggregation is sensitive both to the electrolyte concentration and to the identity of the anion used; and (3) the RNA polymerase-promoter interaction also displays a dramatic dependence on anion type. A general discussion of the molecular origins of an observed electrolyte effect for a protein-DNA-binding system is presented. 37 references, 10 figures, 1 table.

24381 **In vivo expression of lac promoter variants with altered -10, -35, and spacer sequences.** Ackerson, J.W.; Gralla, J.D. (Univ. of California, Los Angeles). pp 473-476 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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Three elements are shown to control the level, in vivo, of expression from a family of mutant lac promoters. Two -35 region mutations reduce but do not eliminate expression from the lac uv5 and P/sup s/ promoters. This demonstrates that the -35 region can modulate expression levels in vivo and in vitro as has been shown previously for the -10 region. The length of the spacer that separates these two elements also modulates the level of expression in vivo. Deviations from the consensus length of 17 bp lead to reductions in promoter expression, in agreement with reductions in in vitro rates of open promoter complex formation. All elements appear to be modulators of expression, consistent with the proposal that all contribute simultaneously to stabilize polymerase during recognition of the promoter. 27 references, 3 figures, 1 table. (DT)

24382 **DNA determinants of promoter selectivity in Escherichia coli.** McClure, W.R.; Hawley, D.K.; Youderian, P.; Susskind, M.M. (Carnegie-Mellon Univ., Pittsburgh, PA; Univ. of Massachusetts Medical School, Worcester). pp 477-481 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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More than 100 promoter sequences have now been reported. The regions of functional importance, based on the locations of mutations, coincide with two small regions of sequence homology centered about 35 bp and 10 bp preceding the start point of transcription. The -35 region has been proposed to be involved in recognition and initial binding and the -10 region is involved in DNA melting. The development of a steady-state initiation assay has provided the first opportunity for a critical assessment of this model. Exami-

nation of the kinetics of open complex formation using this assay permits the direct determination of K/sub B/ and k_3 for any particular promoter. In this paper is summarized preliminary results obtained with a variety of promoters using this assay and discussions on how these results bear on this simple model of promoter function. 21 references, 5 figures.

24383 **Protein blotting as a means to detect sequence-specific DNA-binding proteins.** Jack, R.S.; Brown, M.T.; Gehring, W.J. (Univ. of Basel, Switzerland). pp 483-491 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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A number of observations have raised the possibility that the sequence-specific DNA-binding protein observed in this laboratory might be a proteolytic degradation fragment of some larger molecule. A different means of detecting the sequence-specific protein was devised using a fractionation scheme in which the possibility of proteolytic degradation is reduced to the minimum. To this end a modification of the protein-blotting procedure was developed which permits us to determine whether any of the DNA-binding proteins visualized on a blot prepared from total nuclear proteins will bind in a sequence-specific manner. 15 references, 6 figures.

24384 **Studies of nucleosome structure.** Richmond, T.J.; Finch, J.T.; Klug, A. (Medical Research Council, Cambridge, England). pp 493-501 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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The nucleosome is the elementary DNA-protein unit responsible for the organization of chromatin (for review, see Kornberg 1977; McGhee and Felsenfeld). These investigations have focused on the structure of the nucleosome at atomic resolution and determining how it is assembled in the higher-order structure of chromatin. In this paper is provided a brief summary of our understanding of nucleosome structure at an overall resolution of about 20 A.

24385 **Structure of nucleosomes, chromatin, and RNA polymerase-promoter complex as revealed by DNA-protein cross-linking.** Mirzabekov, A.D.; Bavykin, S.G.; Karpov, V.L.; Preobrazhenskaya, O.V.; Ebralidze, K.K.; Tuneev, V.M.; Melnikova, A.F.; Goguadze, E.G.; Chenchick, A.A.; Beabealashvili, R.S. (Institute of Molecular Biology, Moscow, USSR). pp 503-510 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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Recent studies on the primary organization of DNA-protein complexes formed by covalently binding proteins through their lysine residues to DNA are described. The covalent bonding makes DNA split at the cross-linking site. The length of cross-linked or released DNA fragments determines the position of the cross-linked protein molecules on the DNA. It is shown here that ^{32}P label can be introduced by polynucleotide kinase into a nucleotide tail attached to the protein at the cross-linking site after DNA hydrolyzation. To find proteins that are bound to DNA and that regulate chromatin structure and gene activity, a protein-image DNA hybridization method has been developed for studying proteins bound to specific DNA sequences after their cross-linking. 38 references, 10 figures.

24386 **Cellular and SV40 chromatin: replication, segregation, ubiquitination, nuclease-hypersensitive sites, HMG-containing nucleosomes, and heterochromatin-specific protein.** Varshavsky, A.; Levinger, L.; Sundin, O.; Barsoum, J.; Oezkaynak, E.; Swerdlow, P.; Finley, D. (Massachusetts Inst. of Tech., Cambridge; Cold Spring Harbor Lab., NY; Children's Hospital Medical Center, Boston, MA). pp 511-528 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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SV40 is the first example of a circular, double-stranded replicon that uses multiply intertwined catenated dimers as segregation intermediates. What follows is a condensed account of the DNA-level work on multiply intertwined catenated dimers and on the chromatin organization of SV40 chromosomes during the segregation of daughter DNA molecules. 69 references, 13 figures.

24387 **Cleavage reagents as probes of DNA sequence organization and chromatin structure: Drosophila melanogaster Locus 67B1.** Elgin, S.C.R.; Cartwright, I.L.; Fleischmann, G.; Lowenhaupt, K.; Keene, M.A. (Washington Univ., St. Louis, MO; Harvard Univ., Cambridge, MA). pp 529-538 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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The beads-on-a-string model, in which the 100-A chromatin fiber is constructed by association of the DNA with successive beads, octamers consisting of two each of the four core histones (H2A, H2B, H3, and H4) is supported by numerous lines of evidence. One set of evidence that led to the model is that endogenous nucleases and/or micrococcal nuclease will cut the chromatin fiber to yield a series of fragments, after preferred cutting in the linker region. It was observed here that although digestion of chromatin with micrococcal nuclease generated the expected pattern of oligonucleosomes digestion of chromatin with DNase I yielded a pattern of very large fragments specific to a given locus. This pattern suggests the presence of DNase-I-hypersensitive sites at irregular intervals along the chromatin fiber. 56 references, 10 figures.

24388 **Properties of the chromatin assembled on DNA injected into Xenopus oocytes and eggs.** Gargiulo, G.; Wasserman, W.; Worcel, A. (Univ. of Rochester, NY). pp 549-556 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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The onset of DNA synthesis occurs between 10 and 30 minutes after activation of the egg and thus the transition from nuclease-sensitive to nuclease-resistant supercoils may take place on the newly replicated DNA. To test this possibility, the nonradioactive circular 5-kb DNA carrying the Drosophila histone gene repeat and [α^{-32}P]dCTP were coinjected into fertilized eggs. Such protocol labels both the injected, replicated heterologous DNA and the replicated endogenous, maternal Xenopus DNA. The labeled, presumably replicated, supercoiled DNA is resistant to micrococcal nuclease as expected. The endogenous, high-molecular-weight Xenopus DNA is degraded to 180-bp nucleosomal DNA. Thus, the nuclease resistance is not a general property of chromatin during the cleavage stage of the Xenopus embryo but is a peculiar feature of the injected DNA. 42 references, 5 figures.

24389 **Model for the structure of the active nucleolar chromatin.** Labhart, P.; Ness, P.; Banz, E.; Parish, R.; Koller, T. (ETH-Hoenggerberg, Zurich, Switzerland; Universitaet Zurich, Switzerland). pp 557-564 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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Transcribed ribosomal genes of Xenopus laevis oocytes and of Dictyostelium discoideum were studied electron microscopically using step gradients at different ionic strengths. Under these conditions the fiber of the active chromatin appears smooth and is indistinguishable from free DNA. The accessibility of the coding region and of a nontranscribed spacer region to restriction enzymes and micrococcal nuclease were investigated. All of the results obtained are consistent with a model in which active nucleolar chromatin is mostly composed of free DNA and the components required for transcription. 50 references, 7 figures.

24390 **SV40 morphogenesis.** Bina, M.; Blasquez, V.; Ng, S.C.; Beecher, S. (Purdue Univ., West Lafayette, IN). pp 565-569 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

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To investigate the pathway of SV40 morphogenesis, the assembly-defective mutants, tsB, tsC, and tsBC which synthesize altered forms of the major capsid protein VP1, were analyzed. The properties of DNA-containing particles that are isolated from cells infected with these SV40 tsB and tsC mutants are described. The protein components of tsB201 complexes were determined by SDS-polyacrylamide gel electrophoresis. Unlike tsC219, the core histones not only sediment at 75S, but also extend into the 100S to 160S region of the gradient. Moreover, the major capsid proteins VP1, as well as the minor capsid proteins VP2 and VP3, predominate in the 100S to 160S region. These observations, together with the DNA profile and electron microscopy studies, suggest that the new class of nucleoprotein complexes isolated from tsB201-infected cells consists of SV40 chromatin associated with the capsid proteins. 18 references, 5 figures.

24391 **Nucleosome-core assembly on B and Z forms of poly[d(G-m^{5}C)].** Miller, F.D.; Rattner, J.B.; van de Sande, J.H. (Univ. of Calgary, Alberta). pp 571-575 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

The potential presence of Z-DNA sequences in eukaryote nuclei prompts the question of the effect of Z conformation on DNA packaging and chromatin organization. Reconstitution experiments involving the complexing of histones with poly[d(G-m^{5}C)] have suggested that Z-DNA will not form nucleosomes. However, the observation that anti-Z antibodies will bind to the band regions of polytene chromosomes, indicates that nucleosomal organization of Z-DNA might occur. To address this paradox, a nucleosomal assembly factor isolated from trout testis was used for reconstitution of histones onto poly[d(G-m^{5}C)]. In the presence of this protein, histone complexes can be reconstituted on both the B and Z forms of poly[d(G-m^{5}C)]. The characteristics of isolated reconstitutes suggest that nucleosome-core particles can form with the Z conformation of DNA. 34 references, 4 figures, 1 table.

5503 Cytology

REFER ALSO TO CITATION(S) 24408

24392 **(CONF-840192—) Structure, function, and biosynthesis of plant cell walls: proceedings of the seventh annual symposium in botany.** Dugger, W.M.; Bartnicki-Garcia, S. (eds.). (California Univ., Riverside (USA). Dept. of Botany and Plant Sciences; California Univ., Riverside (USA). Dept. of Plant Pathology). 1984. Contract FG03-84ER13156. 521p. American Society of Plant Physiologists, P.O. Box 1688, Rockville, MD 20850. File Number TI85009403.

From 7. annual symposium in botany - structure, function and biosynthesis of plant cell walls; Riverside, CA, USA (12 Jan 1984).

Papers in the following areas were included in these symposium proceedings: (1) cell wall chemistry and biosynthesis; (2) cell wall hydrolysis and associated physiology; (3) cellular events associated with cell wall biosynthesis; and (4) interactions of plant cell walls with pathogens and related responses. Papers have been individually abstracted for the data base. (ACR)

5504 Genetics

REFER ALSO TO CITATION(S) 24333, 24437

24393 **Selection of hypercellulolytic mutants of Trichoderma reesei based on resistance to nystatin.** Schimenti, J.; Garrett, T.; Montenecourt, B.S.; Eveleigh, D.E. (Rutgers Univ., New Brunswick, NJ). *Mycologia;* 75: No. 5, 876-880(1983).

Nystatin-resistant mutants of Trichoderma reesei were isolated, and several derived from the wild strain showed increased production of cellulase. Thus, the concept of gaining greater enzyme release through interference with membrane function was confirmed. Certain nystatin-resistant mutants derived from the hypercellulolytic strain RUT-C30 also showed increased cellulase yields, but these strains proved unstable and reverted to giving basal enzyme yields.

5505 Metabolism

REFER ALSO TO CITATION(S) 23466, 24392, 24401, 24436

24394 (DOE/ER/10275—1C, pp 1, Paper 43) **Uptake and distribution of estradiol tagged with Iodine-125 in DMBA-induced tumors possessing positive estrogen receptors.** Simpson, P.D. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

Some tumors seem to require hormones, for example, estrogen for maximum growth and will partially regress when deprived of sources of these hormones. Estrogen protein receptors are a means for predicting the hormone dependency of tumors. If estrogen receptors localized in these tumors were used, estrogen tagged with a suitable radioactive isotope might provide a treatment for such tumors. In this study a rat model was utilized to conduct in vivo experiments measuring the uptake and distribution of estradiol labelled with I-125 in subcutaneous tumors and normal tissues. Results of the uptake of the tagged hormone in tumors possessing positive estrogen receptors were compared with those for control tumors and normal tissues. The uptake of the radioactive iodine was found to be too small and too short in duration to be of therapeutic significance.

5506 Medicine

REFER ALSO TO CITATION(S) 23589, 24189, 24263, 24282, 24351, 24408, 24408

24395 (DOE/ER/10275—1C, pp 1, Paper 45) **Method of computerized numerical processing of x-ray images to improve the use of image mask techniques in medical examinations.** Hsu, Z.S.R. (Florida Univ., Gainesville). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

A method is under investigation using a computer to process the digitized experimental image data and allow the intercomparison of a normal image and an abnormal image of x-ray photos, including small adjustments of position, orientation, size, and intensity to more completely mask an abnormal image with a normal image in order to identify and emphasize the abnormalities of the test image. Numerical techniques with sparse matrix algebra and storing algorithms and finite element methods will be used to translate, rotate, and enlarge or reduce the size and/or intensity of normal images in order to obtain a better image mask. This should allow one to reduce or eliminate poor masking caused by small translations occurring between x-ray photos. This will allow one to produce a better image mask without inversion and/or solution of a large system of equations used in many reconstruction methods. This method presents a large potential to reduce the cost and difficulties of reconstruction techniques which are often used. It also has the potential to produce clearer, masked images showing only the abnormal portion of the x-ray, free of distracting background.

24396 (DOE/ER/10275—1C, pp 1, Paper 46) **Ultrasonic dosimetry.** Zitouni, A. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

The calculations of a dose from ultrasonic radiation necessitate an accurate determination of both distribution of energy donated to relevant tissue segments and loss of energy to the surrounding medium. The corrected measurement of the heat produced in the specimens is an indication of the ultrasonic dose received. Several measurements on different types of rubber and meats of comparable sizes but different elastic properties have been performed in our lab at Georgia Tech. A complete description of the apparatus used was presented along with the procedure and the preliminary results.

24397 **(INIS-BR—159) Nuclear accident: dosimetric and medical aspects.** Oliveira, A.R. de. (NUCLEBRAS, Rio de Janeiro (Brazil)). [1985]. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780855.

The conservation aspect of the treatment of patients who received whole-body exposure is presented. Such treatment is to be started during the first hours after the accident (prodomal phase), as well as the nonconventional measures to be adopted when the critical phase of acute irradiation syndrome is reached.

24398 **(INIS-mf—9282) Functional scintiscanning with sup(99m)technetium-diethyl-HIDA as a nuclear diagnostical means in hepatobiliary diseases.** Hummel, G. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Medizin). 26 May 1982. 113p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780856.

The study aimed to delimit the value of sequential hepatobiliary scintiscanning with the aid of sup(99m)technetium-diethyl-HIDA as a diagnostical method in functional or morphological disorders of the gall bladder and bile ducts. The most frequent indications to carry through the investigation therefore were inflammations calculosis in the biliary system, suspected intrahepatic icterus or conditions following biliodigestive anastomoses. Special attention was directed to the question in how far the results were in accordance with those of x-ray cholecystography/cholangiography. Furthermore the possibility for semiquantitative evaluation of serial functional scintiscanning was looked into and clearance determinations were carried through in part of the patients investigated.

5507 Microbiology

REFER ALSO TO CITATION(S) 23590, 24393, 24436

24399 **Monoclonal antibodies for bacterial identification and taxonomy.** Conway de Macario, E.; Macario, A.J.L. (New York State Dept. of Health, Albany). *ASM News;* **49**: No. 1, 1-7(1983). Contract AC02-81ER10880.

Some uses of monoclonal antibodies in bacteriology are discussed with emphasis on identification and classification of microorganisms. It is pointed out that monoclonal antibodies are useful in diagnostic purposes, i.e., identification of bacteria and bacterial antigens in unknowns and classification of new isolates. They are also important for studying relationships among bacteria with phylogenetic significance and for elucidating their ecological history. The procedure for production of monoclonal antibodies is included. A comparison of these antibodies with antisera is made. Data are reviewed illustrating the use of monoclonal antibodies for the study of methanogenic bacteria. A perspective for the future is outlined concerning the potential of panels of monoclonal antibodies to resolve bacterial components of phylogenetic significance. 21 references, 2 figures.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 24392

24400 **(DOE/ER/13273—1) Metabolic mechanisms of plant growth at low water potentials. Progress report.** Boyer, J.S. (Texas A and M Univ., College Station (USA). Research Foundation). Mar 1985. Contract FG05-84ER13273. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010399.

Research progress is reported for studies of the effects of low water potentials on cell enlargement and photosynthesis. The investigations focussed on the localization of water potentials, differences in the response of shoots and roots to low water potential, early signals causing changes in growth rates, and the acclimation of photosynthesis to low water potentials. (ACR)

24401 **(DOE/ER/73019—T1) Irreversible, non-metabolic trapping of extreme levels of protons and sulfate in the brown alga Desmarestia.** Cleland, R.E.; McClintock, M.; Higinbotham, N. (Washington Univ., Seattle (USA). Dept. of Botany). [1984]. Contract AT06-70ER73019;AM06-70RL02225. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009141.

The marine brown alga Desmarestia ligulata accumulates H_2SO_4 to pH's below 1. This is accompanied by nearly stoichiometric accumulation of SO_4^{-2}, with a reduction of cellular K^+ and Cl^{-2}. The mechanism by which these extreme levels are maintained was investigated. It is proposed that once accumulated, the sulfuric acid is held within the vacuole because of an impermeable tonoplast which has no pumps or transport systems for either protons or sulfate ions. 4 refs., 2 tabs. (ACR)

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 23892

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 24329

5601 Radiation Effects

REFER ALSO TO CITATION(S) 24368

24402 **(CONF-8305260—1) Metabolism of ingested uranium and radium.** Wrenn, M.D.; Durbin, P.W.; Howard, B.; Lipsztein, J.; Rundo, J.; Still, E.T.; Willis, D.L. (Utah Univ., Salt Lake City (USA). Radiobiology Div.; Lawrence Berkeley Lab., CA (USA); Utah Dept. of Health, Salt Lake City (USA). Div. of Environmental Health Services; Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil); Argonne National Lab., IL (USA); Kerr-McGee Corp., Oklahoma City, OK (USA). Environment and Health Management Div.). 1983. Contract W-31-109-ENG-38. 89p. NTIS, PC A05. File Number DE85009702.

From Conference on radioactivity in drinking water; Easton, MD, USA (23 May 1983).

Metabolic models for U and Ra are described to estimate the risks to human health from ingesting these elements in drinking water. Chemical toxicity, which is relevant to U in its natural, depleted or slightly enriched state, is addressed, as are the radiotoxicity and the radiobiological effects of the important alpha-emitting isotopes of Ra, including ^{224}Ra, ^{226}Ra, and ^{228}Ra. This paper estimates the kinetics of skeletal U deposition, so that risk coefficients for bone cancer induction can be applied. Skeletal cancer is regarded as the major potential radiobiological effect of ingested alpha-emitting radioisotopes of Ra and the presumed radiobiological effect of U, if any. Best estimates of normal U metabolism are used, because even in extreme cases the amounts of U or Ra ingested in potable water are not great enough to chemically or radiobiologically modify their metabolic behavior.

24403 **(DOE/EV/02725—T4) Repair of DNA treated with λ-irradiation and chemical carcinogens. Progress report, 1984-1985.** Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Biochemistry). 1 Mar 1985. Contract AC02-76EV02725. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010298.

Research progress is reported in the following areas: (1) DNA repair in HeLa cells; (2) a search for human transposable elements; (3) the effect of radiation and carcinogens on the activation of LTR sequences; and (4) studies on oncogenes of central nervous system tumors. (ACR)

24404 **(INIS-BR—154) Radioactive contamination of Bunodosoma caissarum under controlled conditions.** Santos Gouvea, R.deC. dos; Santos, P.L. dos; Azevedo Gouvea, V. de. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Biologia). [1985]. 10p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780854.

The kinetics of uptake and release of radionuclides ^{137}Cs, ^{131}I, ^{133}Ba, ^{51}Cr (III and VI), ^{60}Co and ^{65}Zn in the 'cnidaria' Bunodosoma caissarum have been studied. This is an exclusively Brazilian species and easily collected on the Rio de Janeiro coastal waters. The kinetic experiments have been made in aquariums of 1000 cm^3, in laboratory under controlled conditions and accompanied by single channel radiometry. The velocities of concentration were evident to radionuclides ^{131}I and ^{133}Ba. The larger concentration factors were registred to ^{51}Cr (III), ^{65}Zn and ^{51}Cr (VI), with middle values of 20,0,14,5 and 8,6 respectively. The same radionuclides stood out in the loss experiments, presenting the following biological half-lives : 292,2 h (^{51}Cr-III), 784,0 h (^{51}Cr-VI) and 823,0 h (^{65}Zn). This expressive value for the ^{65}Zn suggests a probable biological integration of this radionuclide by the species studied. The results allow us to indicate the 'anthozoa' Bunodosoma caissarum as a bioindicator of the radioactive contamination of the marine environment.

24405 **(JAERI—1288) Study on the short-term metabolism of curium and its removal with DTPA in the rat.** Takada, Kazuo. (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700902.

The contents of ^{243}Cm in the plasma, liver, skeleton and kidneys were determined from 22.5 minutes to 16 days after the intravenous injection of ^{243}Cm citrate to the rat. The ^{243}Cm injected disappeared from the plasma rapidly and deposited mainly in the liver and skeleton. By analyzing the relationship between the disappearance from the plasma and the accumulation in the organs of injected curium, the initial distribution space, or the actual site of transfer compartment used for dose calculation in the ICRP Publ.30, of curium was identified as the extracellular fluid (ECF). The calculation showed that the difference between the radiation dose to bone surface or red bone marrow from short-lived curium isotopes evaluated under the current ICRP assumption, on one hand, and the same radiation dose, evaluated under the assumption that the actual site of transfer compartment is ECF, on the other, is not negligible. The effect of administration of CaDTPA or ZnDTPA on the retention of ^{243}Cm in organs was studied by changing the time interval between the ^{243}Cm injection and DTPA administration and the amount of DTPA administered. The results obtained showed that 1) DTPA treatment of a person who has incorporated curium into the body should be started as early as possible, 2) the first single prompt DTPA should be administered as Ca salt, and the following multiple delayed DTPA, as the less toxic Zn salt, and 3) the dose of first CaDTPA should be as large as possible within the range not producing its side effect. The study on the mixture of ^{243}Cm and ^{238}Pu showed that these two radioelements are metabolized and removed with DTPA independently.

24406 **(JAERI-M—83-156) Study of internal exposure based on the ICRP Publication 30.** Matsunaga, Takeshi; Kasai, Atsushi. (Japan Atomic Energy Research Inst., Tokyo). Sep 1983. 44p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700901.

A computer program to calculate an internal exposure has been developed. It is based on the ICRP Publication 30. The influences on the committed dose equivalent by the factors such as an activity median aerodynamic diameter(AMAD) of a radioactive aerosol, a chemical state of a radionuclide, its decay constant, and its radiations have been investigated using the program. The following properties have been made clear. In the case of inhalation, the committed dose equivalent in organs except for the gastrointestinal tract(the GI tract) per unit activity intake mostly increases as the AMAD gets smaller. The transformations in the pulmonary parenchyma and especially those in the pulmonary lymphatic system have a great contribution to the committed dose equivalent in the respiratory tract. In general that in the GI tract increases slowly with the AMAD getting larger. In the case of ingestion, the committed dose equivalent in organs except for the GI tract is mostly smaller than that in the case of inhalation. Although the number of the transformations in the GI tract is always larger than that in inhalation, the committed dose equivalent is not necessary greater than that in inhalation for a gamma ray emitter. The reason is that the exposure of the GI tract to gamma rays from the radionuclides in the respiratory tract is often dominant for the GI tract.

24407 **(JINR—19-83-845) Nomograms for estimating the parameters of the probabilistic model of radiosensitivity.** Fajsi, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700896.

Submitted to the journal Radiobiologiya.

Nomograms are introduced for the determination, from experimental survival curves, of parameters a and b of the probabilistic model of radiosensitivity of cells (proposed by Kapul'tcevich, 1978). Parameter errors are estimated too. Some examples of the use of these nomograms are shown for bacteria, yeast and mammalian cells.

24408 **(LBL—18393) Biology and Medicine Division annual report, 1983-1984.** (Lawrence Berkeley Lab., CA (USA)). Apr 1985. Contract AC03-76SF00098. 263p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE85010638.

Separate abstracts were prepared for individual research projects. (ACR)

24409 (NIRS-M—42, pp 181-190) **Age dependence of tritium metabolism.** Inaba, Jiro (National Inst. of Radiological Sciences, Chiba (Japan)). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

^{3}H metabolism in vivo was studied by HTO administration to rats of varying ages for examination of the age dependence of ^{3}H metabolism in humans. When 1 μCi/g body weight of HTO was administered, the time-course changes of urine ^{3}H showed definite age dependence; the younger the rat, more rapidly did the ^{3}H concentration decrease. The biological half-life of whole body residues was about 2 days in nursing offsprings and about 4 days in mature rats. Tissue-bound ^{3}H showed high and rapid distribution to the liver, whereas it was slow in the brain and muscle, and this tendency was more prominent in younger rats. Compared with ^{3}H in tissue water, the concentration of bound ^{3}H was relatively high, being prominent in younger rats. The time-course changes of ^{3}H concentration from both origins also showed age dependence. The in vivo exposure dose after administration of 1 μCi/g body weight of HTO-^{3}H was generally smaller in younger rats, the exposure at ages 10 and 25 days being about a half of that of mature rats. Supposing that human metabolism is similar, the estimated dose in one-year-olds after ingestion of 1 μCi/kg body weight of ^{3}H in the form of HTO is about 3 times that in adults, and that after 1 μCi/kg body weight of ^{3}H in infants, about a half of that in adults.

24410 (NIRS-M—42, pp 191-200) **Incorporation of tritium into body constituent molecules.** Ichimasa, Yusuke (Ibaraki Univ., Mito (Japan)). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

Incorporation of tritium into body constituent molecules from tritiated water and its in vivo behaviors were studies using rats. In single administration of HTO, ^{3}H behaviors were studied in lipids that are rich in hydrogen. Incorporation of ^{3}H into the lipid fraction from HTO and its release differed by each organ and by the type of lipid components. Of routes of administration, the oral and parenteral routes showed the same results, and no prominent difference was noted by inhalation. By consecutive administration, the urine ^{3}H concentration showed no difference according to the route, but increased as the concentration of administered HTO increased. When administration was discontinued after the urine ^{3}H concentration reached a plateau, the biological half-life was about 4.5 days, almost in agreement with the value by single administration. In relation to water intake, increase in the urine volume and accompanying promotion of urine ^{3}H excretion in approximate proportion to water intake were observed. The tissue-bound ^{3}H and total ^{3}H activities decreased in close correlation with increase in water excretion. In consecutive administration, the larger the 24-hour intake, the lower of the ^{3}H equilibrium level in the urine, resulting in a marked decrease in organ ^{3}H concentrations. According to the weekly age of rats, the water intake/body weight was greater in younger rats, and since their water metabolism was active, the ^{3}H concentration in the urine and tissues showed low values.

24411 (NIRS-M—42, pp 201-212) **Incorporation of organically bound tritium into body constituent molecules.** Takeda, Hiroshi (National Inst. of Radiological Sciences, Chiba (Japan)). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

Incorporation of ^{3}H from organic ^{3}H into body constituent molecules through the food chain was studied. Exposure to organic ^{3}H may result in a higher ^{3}H incorporation into animal organs than that by exposure to HTO and to differ according to the type of food (organic form). The effect of the difference in organic forms on the in vivo behaviors of ^{3}H was studied using leucine, glucose and thymidine labelled with ^{3}H in rats. Compared with HTO, all of the incorporations of the 3 ^{3}H compounds into the organic components of rats 24 hours after administration were high, with great differences among the 3 compounds with respect to the level of concentration and the organ distribution. The biochemical distribution of organically bound ^{3}H differed greatly in liver tissues depending on the chemical form of digested ^{3}H. The excretion curve also showed differences that were rather remarkable among organs, according to the chemical form. The accumulated dose in each organ in 100 days after administration was highest for ^{3}H-leucine at 1 μCi/g body weight, being 2 - 3-fold that of HTO.

24412 **(RERF-TR—11-82) Histological review of breast cancer in atomic bomb survivors, Hiroshima and Nagasaki.** Tokuoka, Shoji; Asano, Masahide; Yamamoto, Tsutomu; Tokunaga, Masayoshi; Sakamoto, Goi; Hartmann, W.H.; Hutter, R.V.P.; Henson, D.E. (Radiation Effects Research Foundation, Hiroshima (Japan)). Sep 1983. 16p. (In Japanese and English). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700897.

A group of pathologists from the United States and Japan reviewed breast cancer material of women exposed to the atomic bombs in Hiroshima and Nagasaki and controls. The purpose of the review was to verify the diagnoses, establish a base of confirmed cases for epidemiologic study, and provide a reference for other pathology review. Compared to the control group, matched through the Life Span Study extended sample, there were no differences in distribution of tumor type and tumor size. There were also no differences in histological type by age or radiation dose. The peak age for cancer to develop was the same in the exposed and control groups. The type of radiation had no effect on histological type. Atypical changes or residual proliferative lesions were not found in women exposed to radiation but free from cancer. On the basis of this study, it was concluded that radiogenic breast cancer does not differ histologically from spontaneously occurring cancer in Japanese women.

24413 **Effects of atomic bomb radiation on differentiation of B lymphocytes and on the function of concanavalin A-induced suppressor T lymphocytes.** Yamada, Y.; Neriishi, S.; Ishimaru, T.; Shimba, N.; Hamilton, H.B.; Ohgushi, Y.; Koyanagi, M.; Ichimaru, M. (Radiation Effects Research Foundation, Nagasaki, Japan). *Radiation Research;* **101**: No. 2, 351-355(Feb 1985).

The differentiation of peripheral blood B lymphocytes into immunoglobulin-producing cells (Ig-PC) by pokeweed mitogen (PWM) and the function of concanavalin A (Con A)-induced suppressor T lymphocytes were examined to elucidate the late effects of atomic bomb radiation. A total of 140 individuals, 70 with an exposure dose of 100 rad or more and an equal number with an exposure dose of 0 rad matched by sex and age, were selected from the Nagasaki Adult Health Study (AHS) sample. Both the differentiation of peripheral blood B lymphocytes into Ig-PC by PWM and the function of Con A-induced suppressor T lymphocytes tended to be more depressed in the exposed group than in the control group, but a statistically significant difference could not be observed between the two groups. The function of Con A-induced suppressor T lymphocytes tended to decrease with age, but a statistical significance was detected only for percentage suppression against IgM-PC.

24414 **Effect of continuous, whole-body gamma irradiation upon canine lymphohematopoietic (CFU-GM, CFU-L) progenitors and a possible hematopoietic regulatory population.** Klein, A.K.; Dyck, J.A.; Shimizu, J.A.; Stitzel, K.A.; Wilson, F.D.; Cain, G.R. (Univ. of California, Davis). *Radiation Research;* **101**: No. 2, 332-350(Feb 1985). Contract AC03-76SF00472.

Clonogenic assays for granulocytes-macrophages (CFU-GM) in bone marrow and for T lymphocytes (CFU-L) in peripheral blood were performed on dogs continuously exposed to ^{60}Co irradiation (0.02, 0.04, or 0.11 Gy/day). When decreased numbers of CFU-GM were observed they correlated well with the clinical status of the dogs but were not generally associated with increasing cumulative doses of absorbed irradiation. In clinically normal, irradiated animals, decreased CFU-GM values and myeloid-erythroid ratios were observed, suggesting that chronic irradiation may affect the granulocytic series well before decreased peripheral blood values are seen. In hypocellular dogs the number of CFU-GM were significantly decreased compared to values obtained from control or clinically normal irradiated dogs, while virtually no CFU-GM were observed in the leukemic dogs. Proliferative capacity of T lymphocytes (CFU-L) was not affected by either increasing absorbed irradation or the presence of leukemia, D_0 values were determined on marrow fibroblastic cells to ascertain whether a radioresistant subpopulation of stromal elements would result from continous in vivo irradiation. These radioresistant marrow fibroblastic cells were assayed for their ability to support normal granulopoiesis and found to be not significantly different from control fibroblasts.

24415 **Assessment of radiation doses downwind of the Nevada Test Site.** Anspaugh, L.R.; Church, B.W. (Lawrence Livermore Lab., CA). *Proceedings of the National Council on Radiation Protection and Measurements;* No. 5, 38-39(1 Nov 1983). (CONF-830460—).

From 19. annual meeting of the National Council of Radiation Protection and Measurements; Washington, DC, USA (6 Apr 1983).

The Department of Energy's Off-Site Radiation Exposure Review Project has the goal of reconstructing both individual and population doses via all pathways including the ingestion and inhalation of radionuclides. As this is a reconstruction and not a prediction for safety purposes, the desired output is the best estimate of radiation dose with an appropriate expression of uncertainty. For the 80 events of interest, the data consistently available are external γ exposure-rate measurements, measurements of airborne gross β activity, and measurements of fission yield and of activation products created in the device environment. For most organs, the external γ dose is much greater than the dose from ingestion which, in turn, is much greater than the dose from inhalation. The gastrointestinal tract may receive as large a dose from ingestion as from external exposure, depending upon dietary habits. The dose to the thyroid gland is usually dominated by ingestion and the dose from inhalation can be nearly as large as that from external exposure. Several example calculations are presented for specific individuals.

24416 **Altered structure of ultraviolet-irradiated DNA: evidence for unwinding.** Edenberg, H.J. (Indiana Univ. School of Medicine, Indianapolis). pp 379-382 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

In this paper the author reports that uv radiation causes increased binding of SV40 DNA to benzoylated-naphthoylated DEAE-cellulose (BND-cellulose), increased sensitivity to the single-strand-specific nuclease Sl, and alterations in electrophoretic mobility. These effects are consistent with partial melting and unwinding of the DNA.

5602 Thermal Effects

24417 **(SNV-PM—1773) Effects on bottom fauna, fish and sediment from sediment energy extraction in lakes. A literature review.** Leonardson, L.; Lessmark, O. (Statens Naturvaardsverk, Solna (Sweden)). Feb 1984. 58p. (In Swedish). NTIS (US Sales Only), PC A04/MF A01. File Number DE85751412.

Bottom-fauna studies indicate that low temperature and freezing may affect larval growth, duration of the larval stage and diapaus, pupation, mortality, fauna distribution on sediment bottoms, and size, weight, and fecundity of imagos. Lower bottom-water temperature is expected to result in decreased activity and food-consumption rate in freshwater fish during autumn through spring. This may lead to bad condition and low fecundity. Belica (Leucaspius delineatus Heckel), with a most northern distribution in South Sweden, might disappear or decrease in number as a response to lower temperature. Moreover, it is probable that fish behavior, e.g. schooling, will be influenced by lowered winter temperature. Cooling of the sediment surface is expected to result in lower decomposition rate and slower transport of nutrients to the lake's bottom water. On the other hand, freezing of sediment around the brine pipes located in the sediemnt will probably lead to freeze-out of nutrients from the sediment, which will have a eutrophying effect. Besides, freezing is expected to change both individual particle sizes and the sediment structure as a whole, which most probably will affect both microbial and bottom-fauna activity.(author).

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 23417, 23467, 23894, 23895, 23896, 23897, 24367, 24368

24418 (BNL—51779, pp II.3-II.7) **Definitions of potency.** Fischer, H. (Brookhaven National Lab., Upton, NY). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

An overview is presented of carcinogenic potency and how it relates to a dose-response relationship. One interpretation of potency would be the TD_{50}, i.e., the dose required to give a 50% response, and presumably the inverse of this dose is a measure of the potency for an arbitrary dose-response curve. Since we are interested in very low incremental dose, we're consequently interested in differential effects. So the response is to take the derivative of the fitted dose-response curves. 6 figures.

24419 (BNL—51779, pp II.30-II.31) **Dose-response model derived from cytokinetic considerations provides a means to estimate relative potency factors for neoplastic potentiation.** Jones, T.D.; Walsh, P.J. (Oak Ridge National Lab., TN). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

An equation to estimate neoplasia as a function of cell proliferation has been described conceptually, approximated algebraically, and applied to radiation-induced leukemia in humans and to animal neoplasia resulting from both radiation and chemical treatment schedules. Excellent success has been achieved, and the model has been expanded to a time-to-tumor model. The modeling approach described estimates the composite amount of toxic hyperplasia resulting from a specific stress of concern relative to a cohort test animal or person subject to all conditions except for the stress of study. The doses of B(a)P, benzene, benzidine, chromium, quinoline, 4-biphenylamine, vinyl chloride, formaldehyde, dodecane, and arsenic have all been standardized in units of micromoles of insult per kilogram-body-weight and the response has been expressed as percent-increased response (above the natural rate) per unit-dose. For each of these chemicals, a scatter-diagram is obtained, but a dose-response shape is defined by the envelope of points. The practical threshold values of CO, NO, NO_2, O_3, and SO_2 for neoplastic potentiation are presented. 1 table.

24420 (BNL—51779, pp III.2-III.5) **Risk assessment and risk management.** Rodricks, J. (ENVIRON, Washington, DC). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

A guideline for risk assessment is described in broad terms and an attempt is made to distinguish it from risk management. The components of risk assessment are discussed. The first component is Hazard Identification and Evaluation which examines the epidemiologic and experimental evidence for deciding if it is a carcinogen and what is known about the carcinogen. The second component is Dose-Response Evaluation, which is a potency analysis. The third component is Exposure Evaluation, which is the evaluation of exposure of the population you wish to protect. The last two components (Dose-Response Evaluation, Exposure Evaluation) are combined to give some estimate of the Probability of Harm (fourth component). These four activities are risk assessment, and once all of the information associated with risk is known, then the questions of risk management can be looked at intelligently.

24421 (BNL—51779, pp III.31-III.33) **Some comments on risk assessment methodology and its application.** Van Ryzin, J. (Brookhaven National Lab., Upton, NY). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

An attempt is made to address some of the issues involved in risk assessment. The most common method of doing risk assessment with chronic animal toxicity data is to fit some mathematical model to the data and extrapolate downward to an acceptable risk level. An acceptable risk level is usually a very low lifetime risk. After this extrapolation downward, the animal dose is converted to a human dose usually on the basis of either body weight or surface area. The problem of choosing a mathematical model to fit a specific carcinogenic response is discussed. 8 references.

24422 (BNL—51779, pp IV.4-IV.8) **Carcinogen risk assessments: assumptions and uncertainties associated with animal models.** Crouch, E. (Harvard Univ., Cambridge, MA). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

An attempt is made to outline what happens concerning risk assessment for carcinogens based on animal data. Attention is focused on the uncertainties that may arise and some measure of dose, usually a lifetime average dose. It may be a lifetime average weighted dose or an integrated dose rate. The uncertainties involved in choosing a dose-response model are discussed. The end result is going to be probability distributions for risk with certain assumptions. 2 figures.

24423 (BNL—51779, pp IV.9-IV.15) **Mechanisms of carcinogenesis: implications for expectations about dose-response relationships.** Hattis, D. (Massachusetts Institute of Technology, Cambridge). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

An attempt is made to describe some of the basic features of cancer dose-response curves and the mechanisms underlying carcinogenesis. The key step in most carcinogenesis is some change or rearrangement of information in DNA. The evidence for this concept is outlined. Basically, there are three classical lines of evidence. First, cancer seems to start in single cells, as observed in experiments where cells of a given tumor nearly always have the same X chromosome activated in all the cells. The second is the general association of mutagenic and carcinogenic activities in chemicals. Finally, some well-characterized defects in DNA repair lead to substantial increases in at least some kinds of cancer risk. 3 figures.

24424 (BNL—51779, pp IV.16-IV.33) **Overview of factors that influence the quantitative risk assessment of carcinogens.** Crump, K. (Science Research Systems, Ruston, LA). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

The uncertainties involved in quantitative risk assessment are discussed. They include high-to-low-dose extrapolation, animal-to-human extrapolation, extrapolation from long-to-short exposures, risks to humans exposed to food and the exposures to humans. When a risk assessment is done, a decision has to be made about how to treat each of these areas of uncertainty. For this reason, it is important that there be a unified approach to risk assessment. 1 table.

24425 (BNL—51779, pp IV.34-IV.38) **Practical carcinogen guidelines based upon hazard potential.** Boundy, M.G.; White, O. Jr.; Lillian, D. (Brookhaven National Lab., Upton, NY). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

Current governmental cancer policies and guidelines have a major drawback in their inability to distinguish and recognize the different levels of potency of the numerous carcinogens. The OSHA generic Cancer policy does allow for two separate listings of chemical carcinogens, but within each category all substances are regulated as though they presented the same degree of hazard. Factors such as comparative potency, physical properties, as well as situational factors relating to operational procedures and facilities are not adequately incorporated in existing criteria. A carcinogen guideline is presented consisting of three safety programs based upon the nature of exposure to the specific carcinogenic compounds. A Class I Program (low risk) requires laboratory safety practices and the use of personal protective clothing. A Class II Program (moderate risk) additionally requires work practices and engineering controls in the form of containment systems such as laboratory hoods and glove boxes. A Class III Program (high risk) requires a maximum containment system with sophisticated engineering controls and more stringent work practices.

24426 (BNL—51779, pp IV.39-IV-45) **Mechanisms of carcinogenesis: implications for expectations about dose-response relationships.** Hattis, D. (Massachusetts Institute of Technology, Cambridge). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

The subject of dose-response relationships for carcinogens are discussed from a traditional toxicology, as well as a molecular biology, point of view. Evidence clearly places most carcinogenesis within the molecular biological category. The basic expectation from bimolecular reaction kinetics is that the rate of production of DNA lesions by a reactive chemical intermediate should be a direct linear function of the concentration of the reactive material at the site of reaction. The mechanisms by which the linearity of ultimate cancer dose response that can be expected are presented. These mechanisms include: dose-dependent change in metabolic handling of the carcinogen: the properties of DNA repair systems; contributions to cell division by overt toxic responses to carcinogens at high dose levels; differences between individuals in primary sensitivity and the number of sequential mutations within a cell line required to produce carcinogenic transformation. 8 references.

24427 (BNL—51779, pp V.2-V.13) **Issues in setting de minimis standards.** Spangler, M. (Nuclear Regulatory Commission, Washington, DC). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

The problem of standard-setting in relation to occupational workers is discussed with emphasis on de minimis standards. In standard setting attention is focused on the pathway and mechanisms by which occupational exposure to carcinogens is reacted. The greatest emphasis should be placed on controlling the quality

of the air environment and the inhalation pathway. Some of the questions posed by the author include: what are acceptable risks?; how safe is safe enough?; and how safe is too safe? Another question is whether it makes sense to set de minimis standards when the information base on which to set them is still inadequate. Trial cost-effectiveness criteria are presented.

24428 (BNL—51779, pp VI.20-VI.22) **OSHA's carcinogen policy.** Rodricks, J. (ENVIRON, Washington, DC). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

Policy making is discussed in relation to identifying and regulating carcinogens in the workplace. The Interagency Regulatory Liaison Group (IRLG) was formed in Washington which brought four major regulatory agencies together, The IRLG developed toxicity protocols for all kinds of studies, including a common set for industry to follow. The OSHA cancer policy is evaluated. This 250,000 page record guideline for carcinogen assessment is now the only activity concerning carcinogen policy in Washington.

24429 (UCID—19993-84) **Pollutant body burdens and reproduction in Platichthys stellatus from San Francisco Bay. Final report.** Spies, R.B.; Rice, D.W. Jr.; Montagna, P.A.; Ireland, R.R.; Felton, J.S.; Healy, S.K.; Lewis, P.R. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 107p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85010407.

A two-year study of tissue contaminants, inducible mixed-function oxidase (MFO) activity and reproductive success in San Francisco Bay populations of starry flounder, Platichthys stellatus was conducted to determine if lipid-soluble organic contaminants are having sublethal effects on the reproductive success of these populations. Laboratory-spawned females captured at variously-contaminant sites show a highly significant negative relationship between hepatic MFO activity and fertilization success. We have also found an inverse, significant relationship between concentrations of PCBs and embryological success that suggests a direct toxic effect of these chlorinated biphenyls on reproductive success. Most of the variability in fertilization success is due to female factors; males contribute less than 1% of the variability. It appears that the loss of fertilization potential is due, in part, to excess hydration of eggs and the time between follicle rupture and spawning. San Francisco Bay sediments are extensively contaminated with polynuclear aromatic hydrocarbons, polychlorinated biphenyls, phthalates and novel marine contaminant, benzthiazole-2 (4-morpholinyl). These, and many as-yet-unidentified compounds, account perhaps for several thousand different xenobiotic contaminants. 59 refs., 16 figs., 33 tabs.

24430 **Severity and frequency of SO_2-induced leaf necrosis on seedlings of 57 tree species.** Umbach, D.M.; Davis, D.D. (Pennsylvania State Univ., University Park). *Forest Science;* 30: No. 3, 587-596(Sep 1984). Contract AC02-77EV04497.

Container-grown seedlings or rooted cuttings of 57 tree species common in the northeastern United States were tested during 1977-80 to establish the severity and frequency of SO_2-induced leaf necrosis for each species. Plants were exposed to 0.9 ppm SO_2 (2400 $\mu g\ m^{-3}$) for 2 or 4 hr in controlled-environment chambers. Species were grouped into four sensitivity classes. For seven species considered highly sensitive, more than 40% of the individuals exhibited symptoms, and more than 4% of the leaf surface on a typical individual was necrotic on average. At the other extreme, eight species did not develop symptoms. The results are consistent with a direct relationship between a species tolerance to SO_2 and its shade tolerance.

24431 **Dietary protein effects on cadmium and metallothionein accumulation in the liver and kidney of rats.** Revis, N.W.; Osborne, T.R. (Oak Ridge Reasearch Institute, TN). *Environmental Health Perspectives;* 54: 83-91(Mar 1984). Contract AC05-82ER60094.

The relationship of dietary protein to cadmium absorption and tissue deposition was studied in male Sprague-Dawley rats exposed to different levels of cadmium in the drinking water. In animals fed a high-protein or low-protein diet and drinking water containing 25 or 50 ppm cadmium, liver and kidney cadmium and metallothionein were both significantly higher in rats fed the high-protein diet for 2 to 4 months. These differences may possibly be explained by the concentration of cysteine observed between these two diets. When cysteine was added to the low-protein diet to the level observed in the high-protein diet and fed to rats receiving 25 ppm cadmium in the drinking water, significant dietary differences in liver and kidney cadmium and metallothionein were not observed. The importance of dietary protein to cadmium-induced toxicity was also assessed in these studies. The activity of catechol-o-methyltransferase was used as a measure of cadmium-induced toxicity. The activity of this enzyme in the lung, liver and heart was significantly lower in rats fed a low-protein diet than those fed the high-protein diet and 50 ppm cadmium. Metallothionein concentration in the lung and liver from low-protein-fed rats was approximately half the level observed in rats fed the high-protein diet, which suggests a relationship between cadmium-induced toxicity and metallothionein concentrations. These results illustrate the importance of considering dietary protein (and possibly cysteine) when studying cadmium metabolism in experimental animals. 22 references, 6 figures, 6 tables.

24432 **Statistical association between cancer incidence and major-cause mortality, and estimated residential exposure to air emissions from petroleum and chemical plants.** Kaldor, J.; Harris, J.A.; Glazer, E.; Glaser, S.; Neutra, R.; Mayberry, R.; Nelson, V.; Robinson, L.; Reed, D. (Lawrence Berkeley Lab., CA). *Environmental Health Perspectives;* 54: 319-332(Mar 1984).

An ecologic study design was used to investigate the relationship between exposure to air emissions produced by the petroleum and chemical industries, and average annual cancer incidence and major cause mortality rates among whites in Contra Costa County, California. Estimates for the exposure to major industrial sources of sulfur dioxide, hydrocarbons and oxides of nitrogen were used to subdivide the county by level of exposure to petroleum refinery and chemical plant emissions. Cancer incidence and major cause mortality rates were then calculated for whites in each of the exposure areas. In both males and females, residential exposure to petroleum and chemical air emissions was associated with an increased incidence of cancer of the buccal cavity and pharynx. In males, age-adjusted incidence rates for cancers of the stomach, lung, prostate and kidney and urinary organs were also associated with petroleum and chemical plant air emission exposures. In both sexes, a strong positive association was found between degree of residential exposure and death rates from cardiovascular disease and cancer, and a less strong positive association between exposure and death rates from cerebrovascular disease. There was also a positive association in men for deaths from cirrhosis of the liver. Although these observed associations occurred across areas of similar socioeconomic and broad occupational class, confounding variables and the ecologic fallacy must be considered as possible explanations. In particular, the strong findings in men suggest an occupational explanation of the cancer incidence trends, and the effect observed in cirrhosis mortality suggests that lifestyle variables such as alcohol consumption were not adequately controlled for. 26 references, 1 figure, 6 tables.

24433 **State of research: environmental pathways and food chain transfer.** Vaughn, B.E. (Pacific Northwest Laboratory, Richland, WA). *Environmental Health Perspectives;* 54: 353-371(Mar 1984). Contract AC06-76RL01830.

Data on the chemistry of biologically active components of petroleum, synthetic fuel oils, certain metal elements and pesticides provide valuable generic information needed for predicting the long-term fate of buried waste constitutents and their likelihood of entering food chains. Components of such complex mixtures partition between solid and solution phases, influencing their mobility, volatility and susceptibility to microbial transformation. Estimating health hazards from indirect exposures to organic chemicals involves an ecosystem's approach to understanding the unique behavior of complex mixtures. Metabolism by microbial organisms fundamentally alters these complex mixtures as they move through food chains. Pathway modeling of organic chemicals must consider the

nature and magnitude of food chain transfers to predict biological risk where metabolites may become more toxic than the parent compound. To obtain predictions, major areas are identified where data acquisition is essential to extend our radiological modeling experience to the field of organic chemical contamination. 125 references, 7 figures, 2 tables.

24434 **Ecologic regression analysis and the study of the influence of air quality on mortality.** Selvin, S.; Merrill, D.; Wong, L.; Sacks, S.T. (Univ. of California, Berkeley). *Environmental Health Perspectives;* **54**: 333-340(Mar 1984).

This presentation focuses entirely on the use and evaluation of regression analysis applied to ecologic data as a method to study the effects of ambient air pollution on mortality rates. Using extensive national data on mortality, air quality and socio-economic status regression analyses are used to study the influence of air quality on mortality. The analytic methods and data are selected in such a way that direct comparisons can be made with other ecologic regression studies of mortality and air quality. Analyses are performed by use of two types of geographic areas, age-specific mortality of both males and females and three pollutants (total suspended particulates, sulfur dioxide and nitrogen dioxide.). The overall results indicate no persuasive evidence exists of a link between air quality and general mortality levels. Additionally, a lack of consistency between the present results and previous published work is noted. Overall, it is concluded that linear regression analysis applied to nationally collected ecologic data cannot be used to usefully infer a causal relationship between air quality and mortality which is in direct contradiction to other major published studies. 13 references, 2 figures, 2 tables.

24435 **Use of relative toxicity for risk estimation.** Dudney, C.S.; Walsh, P.J.; Jones, T.D.; Calle, E.E.; Griffin, G.D. (Oak Ridge National Lab., TN). pp 499-513 of Short-term bioassays in the analysis of complex environmental mixtures. III. New York, NY; Plenum Publishing Corporation (1983). Contract W-7405-ENG-26.

The relative potency (toxicity) approach for health effects analysis meets risk assessment requirements. Furthermore, it makes maximum use of available data on human incidence of chronic diseases. Data taken in any biological test system can be analyzed and provide input to the risk assessment process using the relative potency approach. This approach is similar to other health effects assessment protocols but is broader in its consideration of many possible reference chemicals. A major shortcoming of this general approach is the paucity of data which are particularly applicable. On the other hand, if further experimental and theoretical analysis confirms our preliminary observation that relative potency factors are reasonably consistent among biological systems, including man, then perhaps more attention should be given to including a set of reference chemicals in biological test protocols. 11 references, 5 figures.

24436 **Interactions of aflatoxin B_1 and alkylating agents with DNA: structural and functional studies.** Essigmann, J.M.; Green, C.L.; Croy, R.G.; Fowler, K.W.; Buechi, G.H.; Wogan, G.N. (Massachusetts Inst. of Tech., Cambridge). pp 327-337 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

Our recent studies on aflatoxin-induced carcinogenesis have focused on its interactions with cellular macromolecules, particularly DNA. As is the case with most carcinogens, metabolism of AFB_1 is required in order for it to be converted into DNA-binding and other reactive forms that presumably are responsible for its potent biological effects. This work describes results obtained in the construction of an intact genome in which a natural base has been replaced with a chemical-DNA adduct. Our intention is to use this DNA as a probe for evaluating the mutagenic activity of O6-MeGua.

24437 **Carcinogens can induce alternate conformations in nucleic acid structure.** Santella, R.M.; Grunberger, D.; Weinstein, I.B. (Columbia Univ., NY). pp 339-346 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—1-Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

We have found that N-2-acetylaminofluorene (AAF) modification of the C8 position of dG residues can result in two different conformational changes in nucleic acids. In random-sequence DNA, AAF binding results in a localized distortion of the B form of DNA termed base displacement. The carcinogen is inserted into the DNA helix perpendicular to the long axis, and the modified guanine residue is displaced and is in the syn conformation. The modified regions show evidence of denaturation, since they are sensitive to nuclease-Sl digestion and react with a single-strand-specific anticytidine antibody. Recent studies on poly(dG-dC).poly(dG-dC) led to the discovery of Z-DNA, a left-handed helix in which dG residues are in the syn conformation and dC residues are in the anti conformation. We have found by circular dichroism (CD) spectroscopy that the modification of poly(dG-dC).poly(dG-dC) by AAF favors its conversion to the Z form. In addition, base pairing remains intact, since the modified polymer is resistant to digestion with nuclease Sl and does not react with the anticytidine antibody. Modification of poly(dG-m^{5}dC).poly(dG-m^{5}dC) with AAF also induces the Z conformation. However, with this polymer, inversion of the CD spectrum takes place at a much lower level of AAF modification (10%) than with the nonmethylated polymer (>20%). Poly(dG).poly(dC), which cannot adopt the Z conformation, does not show CD changes when modified by AAF, but with this polymer the modification does disrupt base pairing. Taken together, these and other results suggest that the types of conformational changes induced in nucleic acids by carcinogen modification depend on base sequence.

24438 **Footprinting with MPE.Fe(II). Complementary-strand analyses of distamycin- and actinomycin-binding sites on heterogeneous DNA.** Van Dyke, M.W.; Dervan, P.B. (California Institute of Technology, Pasadena). pp 347-353 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

Complementary-strand analyses of distamycin- and actinomycin-binding sites on DNA support the asymmetric model for methidiumpropyl-EDTA.Fe(II) (MPE.Fe(II) footprinting. The footprints appear to be shifted 1 to 2 bp to the 3′ side on each strand and are 1 bp underprotected on the 5′ side. With this model in hand, we expect to define more precisely the binding sites of small molecules on native DNA and to interpret more correctly singlestrand analyses on other DNA restriction fragments.

24439 **Ethidium bromide alters the binding mode of cis-diamminedichloroplatinum(II) to pBR322 DNA.** Merkel, C.M.; Lippard, S.J. (Columbia Univ., New York, NY). pp 355-360 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

In the present study we were interested to learn whether the duplex unwinding and shortening phenomena observed when cis-DDP binds to closed circular DNA were caused by the same platinum-DNA linkage or whether they were chemically separable events. We discovered from changes in the mobility in gel electrophoresis of the form-I and form-II DNA bands that cis-DDP that is allowed to react in the presence of ethidium produces effects on the DNA structure that differ markedly from those obtained when platinum binding is carried out in the absence of ethidium. The results

presented here demonstrate that the mode of binding of cis-DDP to DNA can be changed by altering its structure with ethidium. This conclusion further underscores our previous observation that combination chemotherapy for cancer treatment may be effective at the level of drug binding to the biological target.

24440 **Expression of the mouse metallothionein-I gene alters the nuclease hypersensitivity of its 5' regulatory region.** Senear, A.W.; Palmiter, R.D. (Univ. of Washington, Seattle). pp 539-547 of Cold Spring Harbor symposia on quantitative biology. Volume XLVII, Part 1. Structures of DNA. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1983). (DOE/ER/60098—Vol.1; CONF-8206114—Pt.1). TI83015606

From 47. Cold Spring Harbor symposium - quantitative biology; Cold Spring Harbor, NY, USA (2 Jun 1982).

We have been using the mouse metallothionein-I (MT-I) gene as a model system for studies of gene regulation and hormone action at the molecular level. Expression of the MT-I gene is induced at the transcriptional level both by heavy metals and by glucocorticoid hormones in animals and cultured cells. Transfection experiments reveal that the sequences required for cadmium-regulated expression lie within a 221-bp region (-148 to +63) overlapping the 5' end (+1) of the gene; similarly, only sequences between -95 and +63 are required in mouse oocyte injection experiments. We find that in a variety of tissues and cell lines that can express the MT-I gene, there is a region of DNA 250 to 300 bp long near the 5' end of the MT-I gene that is hypersensitive to both DNase I and staphylococcal nuclease. After induction with cadmium, we observe significantly increased nuclease hypersensitivity within a region between -30 and +60 in a variety of cell types. Thus, all of the sequences primarily responsible for transcriptional regulation of this gene may lie within the hypersensitive region. We suggest that various features of this chromatin structure, established during gene commitment, may be important for the efficient interaction of RNA polymerase and various regulatory proteins with specific DNA sequences.

24441 **Cytogenetic analysis of pulmonary alveolar macrophages from treated mice: the effects of cyclophosphimide and benzene.** Scott, M.J.; Harper, B.L.; Gad-El-Karim, M.; Ward, J.B. Jr.; Legator, M.S. (Univ. of Texas Medical Branch, Galveston). *Environmental Mutagen Society;* vp(Feb 1982).

The lung is a unique organ in environmental toxicology due to its role in chemical absorption, metabolism and clearance. The development of assays for genotoxic events in the lung would allow observation of effects at a site of chemical administration. We are evaluating the genotoxic effects of chemical on the lung by cytogenetic analysis of pulmonary alveolar macrophages (PAM's). Using male, Swiss (ICR) mice and a modified standard lavage technique, we can consistently recover 1.0-1.5 x 10^6 PAM cells per animal. Cells from the lavage material were prepared by standard cytogenetic procedures. In two experiments, cyclophosphamide was administered interperatoneally at 0, 5 or 20 mg/kg to 5-6 animals in each treatment group. This was to ascertain whether a clastogen, administered systemically, would manifest its effects in PAM cells, whether such effects were observable, and whether these effects were dose related. The results, analyzed as percent damaged cells, were respectively, 1.89%, 6.40% and 14.32%, (p-value < .001). Benzene was tested using the PAM cytogenetic technique. Doses of 440 and 880 mg/kg, administered via oral gavage, resulted in increased damage: 43.8% and 55.3% cells containing chromosome breaks, respectively. SKF had no apparent protective effect, suggesting the non-involvement of P-450 metabolism in the clastogenic process. In addition, in benzene treated animals a characteristic lesion involving destabilization of the short arms of acrocentric chromosomes resulted in linkage arrangements in over half of all metaphases. These results are consistent with the clastogenic activity of these agents in bone marrow.

24442 **Photosynthetic response of field-grown soybeans to fumigations with sulfphur dioxide.** Muller, R.N.; Miller, J.E.; Sprugel, D.G. (Argonne National Lab., IL). *Journal of Applied Ecology;* **16**: No. 2, 567-576(1979).

Field-grown soybeans were exposed to three levels of SO_2 to determine the effects of the exposure upon photosynthesis and stomatal resistance. In plots where the mean SO_2 concentration averaged about 790 ppb, photosynthesis was reduced to 37-63% of the control during fumigation. In plots, where SO_2 concentration averaged about 300 ppb, photosynthesis was reduced to 63-83% of the control and, in plots where SO_2 concentration averaged 120 ppb, photosynthesis ranged from 90-137% of the control. Stomatal resistance generally increased in the treated plants; however, the response lagged considerably behind the photosynthetic response, suggesting that stomatal closure did not cause the observed reduction in photosynthesis. Visible injury of the leaf tissue was observed only in the high treatment plot. The significant depression of photosynthesis in plots receiving about 300 ppb SO_2, suggests that SO_2 may reduce productivity without visible symptoms of injury. 35 references, 3 figures, 2 tables.

5604 Other Environmental Pollutant Effects

24443 **(DOE/OR/06021—1) Damaging effects of visible light. [Progress report].** Williams, T.P. (Florida State Univ., Tallahassee (USA)). 1979. Contract AS05-78OR06021. 40p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010343.

When rats are exposed to low intensities of light for extended periods of time, they suffer the death of their visual photoreceptors. The proposal is aimed at elucidating the mechanisms whereby the damage occurs. Specifically, the proposal considers photodynamic oxidation of retinal cells as a possible cause of damage and, eventually, death. A brief review of the importance of photodynamic action is given and its relationship to visual cells is pointed out. It is shown, for example, that the components of visual pigments, themselves, are candidates both for producing singlet oxygen (a known cellular oxidant) and for becoming damaged. Thus, a scheme is proposed as one possibility: retinaldehyde, the visual chromophore, sensitizes the production of singlet oxygen which then oxidizes the highly unsaturated fatty acids of the membrane lipids. The oxidation products (chiefly aldehydes), in turn, attack amino groups on the visual pigment protein, opsin, and render it unable to properly regenerate visual pigment. "Lipofusin" fluorescence in receptors will be determined and the rate and extent of pigment regeneration will be ascetained. Preliminary results are given. 56 refs., 2 figs.

57 HEALTH AND SAFETY

24444 (BNL—51779, pp III.6-III.30) **Risk assessment methodology and its application.** Van Ryzin, J. (Brookhaven National Lab., Upton, NY). Jun 1984. NTIS, PC A11/MF A01. File Number DE85005652. (CONF-8209268—).

From Workshop on problem areas associated with developing carcinogen guidelines; Upton, NY, USA (7 Sep 1982).

An attempt is made to describe the low-dose extrapolation problem as an aspect of risk assessment for carcinogens. Emphasis is on using animal data for doing low dose extrapolation. Three aspects of the problem are explored: quantal response data, the dose-response curve, and the acceptable risk level. Some data sets are presented to which four different models have been applied - the one-hit model, the multistage model, the multihit model, and the Weibull model. Dose-response models allow for low-dose estimates of virtual safe dose at a variety of risk levels; they are extremely model dependent; and for some regulatory purposes, researchers may want to extrapolate to some intermediate risk level and then linearly extrapolate beyond that. 3 figures, 8 tables.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 23430, 23536, 23556, 23570, 23571, 23702, 24461, 24462, 24463, 24477

24445 (AECL—7822, pp 5-13) **Battelle experience with geologic simulation modeling.** Foley, M.G.; Petrie, G.M. (Battelle Pacific Northwest Laboratories, Richland, WA). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

Geologic simulation modeling has been pursued for the past six years under US Department of Energy sponsorship at the Pacific Northwest Laboratory administered by Battelle Memorial Institute. A preliminary Geologic Simulation Model (GSM) has been completed for the Columbia Plateau, and one is under development for the Nevada Test Site. These GSMs are quasi-deterministic process-response models that simulate the development of the geologic and hydrologic systems of a specific groundwater basin containing a high-level nuclear waste (HLW) repository for a million years into the future. This report discusses GSMs briefly and, based on Battelle's experience with geologic simulation modeling, suggests considerations that will influence the incorporation of transitional events and gradual changes into the Canadian Systems Variability Analysis Code (SYVAC).

24446 (AECL—7822, pp 40-57) **Astronomical Climatic Index and its value for predicting future climate.** Matthews, J.V. Jr. (Geological Survey of Canada, Ottawa, Ontario). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

The long-term instability of world climate and the potential for glaciation in areas where nuclear wastes are buried has previously been studied using an Astronomical Climate Index (ACLIN) which is based on orbital forcing and is calibrated to the marine record of climate change and world ice volume. It is shown that the marine paleoclimatic record does not in every case provide an accurate record of terrestrial climatic events and that other climate forcing functions also need to be considered.

24447 (AECL—7822, pp 58-72) **Past geological conditions and their relevance to present-day fracture flow systems.** Brown, P.A.; McEwen, J.H.; Rey, N. (Atomic Energy of Canada Ltd., Chalk River, Ontario). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

The tectonic and fracture history of Eye-Dashwa Pluton within the Wabigoon volcanic belt of the Canadian Shield is discussed. Their relevance to current and future fracture-flow systems and the implications for nuclear waste burial are discussed.

24448 (AECL—7822, pp 73-96) **Phanerozoic and recent tectonic movements in the Canadian Shield and their significance to the Nuclear Fuel Waste Management Program.** Sanford, B.V.; Thompson, F.J.; McFall, G.H. (Geological Survey of Canada, Ottawa, Ontario). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

Results to date from a study on Phanerozoic tectonic reconstructions of the eastern craton and on implications for present-day geodynamic processes and their effects on underground waste storage vaults are presented.

24449 (AECL—7822, pp 97-108) **Relationship between the present fracture state and the long-term (Archean to present) tectonic and uplift history of northwest Ontario.** West, G.F. (Univ. of Toronto, Ontario). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

The geologic and tectonic history of northwest Ontario is described with a few toward explaining the present fracture system and hydrology. Implications for future changes in the system are discussed as related to siting waste disposal vaults.

24450 (AECL—7822, pp 174-190) **Applications of techniques of glacial geology to radioactive waste disposal modelling.** Shilts, W.W. (Geological Survey of Canada, Ottawa, Ontario). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

The purpose of this paper is to illustrate the types of glacial geological studies that can have relevance in modelling or assessing the geological factors that bear on the suitability of a site for the storage of high-level radioactive waste. Some of the studies relate to the long-term suitability of a storage site, and some relate to short-term stability.

24451 (AECL—7822, pp 191-199) **Glacial and postglacial stress changes in Ontario and Quebec: their implications for rock fracture studies.** Adams, J. (Energy, Mines and Resources Canada, Ottawa, Ontario). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

Cyclic glacial-deglacial loading represents one of the largest and certainly most recent perturbations to crustal stresses in Canada. The direct evidence for past stress states in Ontario and Quebec comes from old stress-relief phenomena. The nature of these are summarized and their implications for rock fracturing are discussed.

24452 (AECL—7822, pp 200-211) **Conditions at the ice/rock interface of large ice sheets.** Koerner, F.M. (Energy, Mines and Resources Canada, Ottawa, Ontario). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

The concept of the disposal of nuclear fuel waste in stable areas of the Canadian Shield is being assessed. Because of the long half-life of some of the fission products, an undisturbed life expectancy of a deep disposal vault (1000 m) of about 1×10^6 a (1 Ma) is desirable. As the Canadian Shield has been ice-covered (by the Laurentide Ice Sheet) for about 90% of the past 1 Ma, a knowledge of conditions at the ice/rock interface is of the utmost importance. The main problems concerning vault integrity under a thick ice sheet are (a) erosion of the vault roof by the ice sheet, (b) increased availability of water and increased water pressure under the ice sheet, and (c) increased stresses on the rock produced by the overlying weight of the ice sheet, such that fracturing can occur. This paper presents a general introduction to the thermal regime and dynamics of ice sheets in terms relevant to nuclear waste disposal. A single-domed ice sheet with its center over Hudson Bay will be considered. The existence of other domes does not radically alter the basic arguments presented here, although their incorporation into a final model may prove necessary.

24453 (AECL—7822, pp 212-230) **Potential hydrodynamic effects of glaciation on the Canadian Shield.** Vonhof, J.A. (Vonhof Consulting Ltd., Calgary, Alberta). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

Glaciation of the present land surface will change the boundary conditions for ground water flow and, subsequently, the ground water flow pattern. Within the fractured crystalline rock environment of the Canadian Shield, these changes will result in differential erosion of the land surface. It appears that the ground water flow pattern in the total system, i.e., glacier ice and underlying bedrock, will be largely controlled by the interface area and that most of the ground water flow will be concentrated in this zone. Because of the complexity of ground water flow patterns, which will be subject to considerable changes during glaciation, modeling will be necessary to approximate the change in the ground water flux in the deeper rock environment, i.e., vault site. However, modeling should only then be attempted when the hydrogeological environment on both a local and a regional scale is reasonably well defined.

24454 (ANL/EES-TM—270-Vol.2) **Movement of tagged dredged sand at thalweg disposal sites in the Upper Mississippi River. Volume 2. Savanna Bay and Duck Creek sites.** Paddock, R.A.; McCown, D.L. (Argonne National Lab., IL (USA)). Dec 1984. Contract W-31-109-ENG-38. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85010186.

Experiments were conducted on the Upper Mississippi River at two sites, Savanna Bay and Duck Creek, to investigate the movement of dredged sand after disposal in the thalweg. These experiments are part of a larger study, which includes similar experiments conducted earlier at two other sites on the Upper Mississippi River. At the Savanna Bay site, hydraulically dredged sand was tagged with sand coated with fluorescent dye before being deposited as a pile in the thalweg. Bathymetric surveys and surficial bottom sampling were conducted on five occasions over a nine-month period following disposal to identify changes in the topography of the pile and to detect the presence of dyed sand. At the Duck Creek site, only bathymetric surveys were conducted. The general behavior of the disposal piles at these two new sites was similar to that of the piles at the first two sites. Topographic evidence of the piles disappeared, and bottom conditions similar to the predisposal conditions were reestablished following the first period of high river flows after disposal. At Savanna Bay, as had happened at the first two sites, the tagged sand remained in the main river channel as it moved downstream in response to flood currents and did not migrate into nearby border areas, backwaters, or sloughs. 6 references, 89 figures, 2 tables.

24455 (CBPF-NF—046/82) **Influence of climatic oscillations in the archaeological sequence on Marajo Island, Brazil.** Meggers, B.J.; Danon, J.; Ferreira, J.; Valladas, H. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700497.

Thermoluminescence dates define the durations of five successive archaeological complexes or phases on the island of Marajo, providing a chronology extending from about 34000 B.P. to European contact. A hiatus of 930 + - 300 years coincides with a period of aridity between about 2700 and 2000 B.P. inferred from pollen sequences in various parts of the neo-tropical lowlands, suggesting that Marajo may have been abandoned by pottery-making groups during this interval because of subsistence stress.

24456 (NIRS-M—42, pp 85-93) **Move of ground water.** Kimura, Shigehiko (National Research Inst. of Agricultural Engineering, Yatabe, Ibaraki (Japan)). 1983. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. File Number DE85780802. (CONF-8112113—).

From 9. NIRS environmental seminar on study of tritium behavior in environment and human body; Chiba, Japan (22 Sep 2517).

As a ground water flow which is difficult to explain by Darcy's theory, there is stagnant water in strata, which moves by pumping and leads to land subsidence. This is now a major problem in Japan. Such move on an extensive scale has been investigated in detail by means of ^3H such as from rainfall in addition to ordinary measurement. The move of ground water is divided broadly into that in an unsaturated stratum from ground surface to water-table and that in a saturated stratum below the water-table. The course of the analyses made so far by ^3H contained in water, and the future trend of its usage are described. A flow model of regarding water as plastic fluid and its flow as channel assembly may be available for some flow mechanism which is not possible to explain with Darcy's theory.

24457 (ORNL/Sub—84-64794/1) **Shales and other argillaceous strata in the United States.** Gonzales, S.; Johnson, K.S. (Earth Resource Associates, Inc., Athens, GA (USA)). Mar 1985. Contract AC05-84OR21400. 616p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE85010453.

This report presents detailed geologic and hydrologic data that describe shales and other argillaceous rocks; data are from the open literature. These data are intended to be used in the future to aid in assessment of various strata and their potential for repository siting. No observations, conclusions, or recommendations are made by the authors of this report relative to the suitability of various argillaceous rocks for waste disposal. There are, however, other published reports that contain technical data and evaluative statements regarding the suitability of various argillaceous rocks for repository siting. Where appropriate, the authors of this report have referenced this previously published literature and have summarized the technical data. 838 refs., 121 figs., 6 tabs.

24458 (SKBF-KBS-TR—83-74) **Fissure fillings from Gideaa, central Sweden.** Tullborg, E.L.; Larsson, S.Aa. (Swedish Nuclear Fuel Supply Co., Stockholm). Aug 1983. 55p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700891.

The most frequent fissure filling minerals at Gideaa are calcite, chlorite, pyrite, laumontite, stilbite, smectite, quartz and epidote. Potentially young minerals, i.e. minerals which can be formed during present conditions, are smectite, calcite and quartz, Equilibrium calculations show that these minerals can be stable in the water analysed from Gideaa. In borehole Gi 2, the water exhibits a greater equilibrium with existing minerals in the fissures than water from Gi 4. This is due to the recharge of the water in Gi 4 and discharge of the water in Gi 2. When carbonate saturated water penetrated through the bedrock, calcite precipitated within the more superficial portions of the rock. However, both calcite and zeolite fissures fillings are associated with certain zones in the drill holes. A large number of fractures can be concluded to be of post-Jotnian age. Stilbite, calcite and smectite are associated with these fractures. Laumontite can also be assumed to belong here. The dolerites in the area exhibit a high fracture frequency but a relatively low hydraulic conductivity. This is due to the fact that smectite is very prevalent in the dolerite fractures. Several generations of fracturefilling minerals (above all calcite) have been found in a single fracture. Stable isotope analyses of fissure filling calcites indicate that there are three different groups of calcite. Most of the calcites could not have been precipitated from water of present-day isotope composition at Gideaa, whereas recent calcite may be found in one of the groups. Another group of calcite was precipitated during hydro-thermal conditions.

24459 (USGS-OFR—83-668) **Compilation of revised ages of volcanic units in the San Juan Mountains, Colorado: recalculated K-Ar age determinations using IUGS constants.** Hon, K.; Mehnert, H.H. (Geological Survey, Denver, CO (USA)). 1983. 16p. US Geological Survey, Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901333.

Previously published K-Ar age determinations for the middle to late Tertiary San Juan volcanic field have been recalculated using the 1977 IUGS constants. Revised ages, original analytical data, and brief sample descriptions are presented for all available dated volcanic units. A generalized stratigraphic column is also in-

cluded to facilitate comparison of the ages of major volcanic events among more recent publications and previously published papers. No attempt has been made to assess the validity of individual K-Ar ages and, for the purpose of interpretation, the reader is referred to the original source. 23 refs., 2 tabs.

24460 **(USGS-TR—42) Geohydrologic framework of the Roswell ground-water basin, Chaves and Eddy Counties, New Mexico.** Welder, G.E. (Geological Survey, Roswell, NM (USA)). 1983. 198p. New Mexico State Engineer Office, Bataan Memorial Bldg., Santa Fe, NM 87503. File Number TI85901214.

This report describes the geohydrology of the Roswell ground-water basin and shows the long-term hydrostatic-head changes in the aquifers. The Roswell ground-water basin consists of a carbonate artesian aquifer overlain by a leaky confining bed, which, in turn is overlain by an alluvial water-table aquifer. The water-table aquifer is hydraulically connected to the Pecos River. Ground-water pumpage from about 1500 wells in the basin was about 378,000 acre-feet in 1978. Irrigation use on about 122,000 acres accounted for 95% of that pumpage. Permeable zones in the artesian aquifer are generally controlled by lithologic changes in the Permian San Andres Limestone and Grayburg Formation and by fractures in the carbonate rock. The thickness of the artesian aquifer in the more heavily pumped part of the basin ranges from 260 to 460 feet. The confining bed is composed of slightly to moderately permeable rocks of the Permian Grayburg, Queen, and Seven Rivers Formations. The shallow aquifer is composed of permeable beds of sand and gravel in the valley-fill alluvium, which is Pliocene, Pleistocene, and Holocene in age. In 1975, the maximum saturated thickness of the valley fill was about 250 feet in depressions northeast of Roswell, south of Dexter, and at Artesia. Hydrostatic heads in the artesian aquifer declined 230 feet in the south part of the basin from 1905 to 1975. The maximum decline in the head of the shallow aquifer from 1938 to 1975 was 120 feet. The chloride concentration of ground-water samples collected in 1978 ranged from 15 to 7000 milligrams per liter for the artesian aquifer and from 20 to 3700 milligrams per liter for the shallow aquifer. The chloride content has gradually increased through the years in the eastern parts of both aquifers. 31 refs., 28 figs., 1 tab.

5802 Geophysics

REFER ALSO TO CITATION(S) 23713, 24449

24461 (AECL—7822, pp 109-122) **Glacio-isostatic deformation in Ontario.** Bowlby, J.R. (Ontario Hydro, Toronto). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

The following examination of the epeirogenic crustal deformation, which resulted from the Laurentide ice mass, outlines an approach to the determination of the aggregate amount of crustal depression that occurred in Ontario. This analysis is based on a simplified evaluation of the crustal relaxation or uplift component, which is related to the postglacial portion of the cycle. It is considered that similar ice-induced subsidence and rebound cycles were incurred with each of the major glaciations.

24462 (AECL—7822, pp 123-135) **Glacially induced stress changes.** Asmis, H.W.; Lee, C.F. (Ontario Hydro, Toronto). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

From a geomechanics point of view, the glacially induced deformation implies that significant changes took place in the state of stress in the Earth's crust during the Pleistocene. Maximum thicknesses on the order of 3000-3750 m have been deduced by Paterson and Cathles for the Laurentide Ice Sheet, based on ice flow considerations. This means a maximum vertical load of 21-28 MPa on much of the Canadian Shield during the Wisconsin Glaciation. A reconstruction of the stress history through glaciation and deglaciation is difficult, in light of the transient nature of this glacial load - both laterally and vertically, caused by the numerous retreats and re-advances of the ice front. However, some conceptual models of stress changes under glacial load could be developed, in order to gain insight into the stability and integrity of crustal rocks during future glaciations. This article examines a number of such models and relates them to contemporary seismic occurrence in an intraplate environment.

24463 (AECL—7822, pp 136-173) **Stress field and transient stress generation at shallow depths in the Canadian Shield.** Hasegawa, H.S. (Energy, Mines and Resources Canada, Ottawa, Ontario). May 1984. AECL-Scientific Document Dist. Office, Chalk River, Ontario, Canada $15.00. File Number TI84901541. (CONF-8211198—).

From Workshop on transitional processes; Ottawa, Canada (5 Nov 1982).

A prominent feature of the stress field in eastern Canada is the high horizontal stress at shallow depths. Possible causative factors to this shallow stress field are remanent stresses from a previous tectonic orogeny, plate tectonic stresses and glacial-related stresses (glacial drag and flexual stress). The inherent difficulty in differentiating residual from current stress is one of the reasons why the relative contributions to the stress field from the phenomena described above are not properly understood. Maximum stress-strain changes an underground vault is likely to encounter from natural phenomena should occur when the periphery of the advancing or retreating glacier is near the vault. Theoretical calculations indicate that lithospheric flexure, differential postglacial uplift and possibly glacial drag may be able to generate significant horizontal stresses around a vault. In order to calculate the earthquake potential of these induced stress changes, the ambient tectonic stress field should also be included and a suitable failure criterion (e.g. Coulomb-Mohr) used. For earthquakes to generate appreciable stress-strain concentrations near a vault (i) the seismic signal must contain appreciable energy at appropriate frequencies (wavelengths comparable to vault dimensions) and be of appreciable duration, (ii) the particle velocity must be high (>10 cm/s); induced strain is a function of particle velocity and (iii) the hypocenter must be less than half a fault length from the vault for residual deformation (strain and tilt) to be significant. The most severe case is when the causative fault intersects the vault.

24464 **(DOE/CH—6(2)App.C-D) [Revised draft: Southeastern Regional geologic characterization report. Appendices C and D].** (Battelle Memorial Inst., Argonne, IL (USA). Office of Crystalline Repository Development). Nov 1984. 596p. NTIS, PC A25/MF A01. File Number DE85008285.

Appendix C provides a compilation of the historical and instrumental seismic record for the southeastern United States. Table C-1 is a catalog of all earthquakes in the southeastern United States from the year 1698 through 1981. Table C-2 is a listing of the aftershocks and earthquakes recorded in the Charleston-Summerville, South Carolina area from Taber (1914), as listed by Bollinger (1975). Table C-3 lists the seismic events recorded in Trotter's diary for Charleston-Summerville, South Carolina, as listed by US Geological Survey. Appendix D contains a compilation of rock and mineral resource data for the states of Georgia, Maryland, North Carolina, South Carolina, and Virginia. 87 refs.

24465 **(DOE/CH/93028—T1) Geodynamics in the 1980's.** (National Academy of Sciences - National Research Council, Washington, DC (USA). Geophysics Research Board). 1980. Contract AT01-76CH93028. 64p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010115.

The report sets forth a program of continuing and new activities believed to be of first order importance during the opening years of the coming decade. The principal focus for geodynamics studies is crustal dynamics, with emphasis on the origin and evolution of continental and oceanic crust, the continent - ocean transition, the relation of mantle dynamics to crustal dynamics, and a framework for understanding resource systems and natural hazards. (ACR)

24466 **(N—85-13290) Geothermal studies in Alaska: Conditions at Prudhoe Bay.** Lachenbruch, A.H.; Sass, J.H.; Marshall, B.V.; Moses, T.H. Jr.; Munroe, R.J.; Smith, E.P. (Geological Survey, Alexandria, VA (USA)). 1984. 2p. Issuing Activity.

In its the United States Geologicaly Survey in Alaska, 19-20p, (N—85-13283 04-42).

The thermal regime in the Prudhoe Bay area on the coast of the Beaufort Sea was studied on the basis of temperature measurements through permafrost in the Prudhoe Bay oilfield. Analysis of these data, and of thermal conductivity measurements on samples of drill cuttings and frozen core indicate: (1) the heat flow from the Earth's interior is 1.3 + or - 0.2 heat-flow units (HFU) (55 + or - mW/sq sq m), a value typical of stable continental regions; (2) the permafrost on land near Prudhoe Bay extends to a depth of 630+ m, 50 to 100 percent deeper than permafrost in the Barrow area. This greater depth is caused by the high thermal conductivity of the coarse ice-rich siliceous sediment in the Prudhoe Bay area, (3) in the Prudhoe Bay area the nnual increase averages about 1.8 C (from -10.9 C to -9.1 of temperature C) and is associated with a net accumulation of 5 to 6 kcal/sq cm by the Earth's surface during this period, and (4) rising sea level and thawing seacliffs probably caused the shoreline to advance tens of kilometers in the past 20,000 years, so that a part of the Continental Shelf that is presently the target of intensive oil exploration was inundated. A simple heat-conduction model suggests that the warm seabed will cause the base of ice-rich permafrost to rise about 10 m (from 60 + or - m) during the first 2,000 years after inundation, and thereafter it will rise about 15 m per 1,000 years.

24467 **(NUREG/CR—3174-Vol.2) Geophysical-geological studies of possible extensions of the New Madrid Fault Zone. Annual report for 1983. Volume 2.** Hinze, W.J.; Braile, L.W.; Keller, G.R.; Lidiak, E.G. (Purdue Univ., Lafayette, IN (USA); Texas Univ., El Paso (USA); Pittsburgh Univ., PA (USA)). Apr 1985. 58p. NTIS, PC A04/MF A01 - GPO $4.50. File Number TI85901341.

Recent geophysical investigations have shown that the seismicity of the New Madrid, Missouri seismogenic region is correlative with an ancient rift complex suggesting that the anomalous seismicity is the result of the localization of the regional compressive stress pattern by basement structures. Preliminary evidence indicates that this inferred basement rift complex extends beyond the immediate realm of the intense New Madrid region microseismicity. An integrated geophysical/geological research program is being conducted to evaluate the rift complex hypothesis as an explanation for the earthquake activity in the New Madrid area and its extensions, to refine our knowledge of the structure and physical properties of the rift complex, and to investigate the possible northern extensions of the New Madrid Fault zone, especially the possible northeastern connection to the Anna, Ohio seismic region. Investigation of the northeast extension of the New Madrid Rift Complex into eastern Indiana, north of 39°N latitude, has focused upon the acquisition and preparation of arrays of gravity and magnetic anomaly data sets. Another possible arm of the New Madrid Rift Complex, the St. Louis Arm, which extends northwesterly from southern Illinois along the Mississippi River to St. Louis, Missouri, is being studied by an integrated geophysical, seismicity and geological investigation. However, during 1983, special emphasis was placed upon integration of gravity and magnetic anomaly data from the Anna, Ohio seismogenic region with basement lithologic and seismicity information to investigate the possible relationship of basement geology to the seismicity of the Anna area. Interpretation of these data indicate the occurrence of several major lithologic/structural features in the crust of the Anna area. Current seismicity in this region appears to be related to an ancient rift structure and possibly its contact with a low density pluton. 18 refs., 37 figs.

24468 **(NUREG/CR—4226) New Madrid Seismotectonic Study: activities during fiscal year 1983.** Buschbach, T.C. (Saint Louis Univ., MO (USA)). Apr 1985. 150p. NTIS, PC A07/MF A01 - GPO $5.50. File Number TI85901376.

The New Madrid Seismotectonic Study is a coordinated program of geological, geophysical, and seismological investigations of the area within a 200-mile radius of New Madrid, Missouri. The study is designed to define the structural setting and tectonic history of the area in order to realistically evaluate earthquake risks in the siting of nuclear facilities. Our studies concentrated on defining boundaries of a proposed rift complex in the area, as well as establishing the relationships of the east-west trending fault systems with the northwest-trending faults of the Wabash Valley and New Madrid areas. There were 204 earthquakes located in 1983. In addition, the earthquake swarm in north-central Arkansas continued throughout the year, and 45,000 earthquakes have been recorded there since January, 1982. Current seismic activity in the Anna, Ohio, area appears to be related to the northwest-trending Fort Wayne rift and possibly with the rift's contact with a low-density pluton. Fault studies of the Rough Creek-Shawneetown Fault System showed mostly high-angle normal faults with a master fault that is a high-angle south-dipping reverse fault. Trenching of terrace deposits along the Kentucky River Fault System confirmed some anomalous conditions in terrace deposits previously indicated by electrical resistivity and augering programs. Thermal and chemical data from groundwater in the Mississippi Embayment appear to be useful in localizing deep faults that cut through the aquifers. Early indications from studies of jointing in Indiana are that the direction of major joint sets will be useful in determining regional stress directions. No Quaternary faulting was found in the Indiana or Illinois fault studies.

24469 **(USGS-OFR—83-576) Assessment of a prototype earthquake prediction network for southern California.** Dieterich, J.H. (Geological Survey, Menlo Park, CA (USA)). 1983. 28p. US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901338.

This report presents a rationale for earthquake prediction and outlines the components of a prototype operational earthquake prediction network for southern California. 8 refs., 5 figs., 3 tabs.

24470 **(USGS-OFR—83-592) Earthquake activity and ground shaking in and along the eastern Gulf of Alaska. Final report, July 1, 1975-September 30, 1981.** Lahr, J.C.; Stephens, C.D. (Geological Survey, Menlo Park, CA (USA). Office of Earthquakes, Volcanoes, and Engineering). 1983. 51p. US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225. File Number TI85901285.

The objective of this research has been to develop information necessary for improved assessment of the hazards posed by earthquakes to development of oil and gas within the northeast Gulf of Alaska (NEGOA) and adjacent onshore areas. The NEGOA region lies along the boundary of the North American and Pacific lithospheric plates and is seismically active due to the relative motion of these plates. A kinematic model has been developed which specifies the slip rates on the principal faults that accommodate the relative plate motion and this model allows an estimate to be made of the long-term rate of seismicity on each fault. Based on this model and on the theory of seismic gaps, the coastal zone between Icy Bay and Kayak Island is thought to be a likely site for a magnitude 8 or larger earthquake within the next two or three decades. The model also suggests that infrequent great (M/ sub s/ > 8) earthquakes could occur on the low-angle megathrust zone which is thought to underlie the entire continental shelf between Cross Sound and Kayak Island. In addition to the hazard from infrequent great events, moderate and large-size earthquakes (5.5 < M/sub s/ < 8) could occur throughout the entire coastal zone and pose a more localized hazard. This type of event could occur along the underlying megathrust zone or on faults within either of the interacting lithospheric plates. The source regions for such events are not limited to areas that are currently experiencing relatively high rates of microearthquake activity. 43 refs., 18 figs.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 23556, 23565, 23567, 23703, 24457, 24464

24471 **(INIS-BR—155) Mineralogic and sedimentologic characteristics of the Lagoa de Araruama, RJ - Brazil.** Rodrigues, A.B.; Boardman, M.R. (Universidade Federal Fluminense, Niteroi (Brazil)). 1982. 15p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85780852.

From 4. Symposium of the Quaternary in Brazil; Rio de Janeiro, RJ (Brazil) (1981).

The mineralogic variation of clay minerals in the Araruama Lagoon is demonstrated by X-ray diffraction analysis of 45 samples of clay-sized material.

24472 **(NP—5901277) Evaluation of the Santee Limestone for use in flue-gas desulfurization systems.** Mittwede, S.K. (South Carolina Geological Survey, Columbia (USA)). May 1984. 7p. NTIS, PC A02/MF A01. File Number DE85901277.

Open-File Report 38.

The report examines the suitability of the Santee Limestone for use in wet limestones scrubbing systems. Delimiting physical and chemical characteristics are emphasized. 2 refs.

24473 **(UCRL—53558) Petrologic and geochemical characterization of the Topopah Spring Member of the Paintbrush Tuff: outcrop samples used in waste package experiments.** Knauss, K.G. (Lawrence Livermore National Lab., CA (USA)). Jun 1984. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010449.

This report summarizes characterization studies conducted with outcrop samples of Topopah Spring Member of the Paintbrush Tuff (Tpt). In support of the Waste Package Task within the Nevada Nuclear Waste Storage Investigation (NNWSI), Tpt is being studied both as a primary object and as a constituent used to condition water that will be reacted with waste form, canister, or packing material. These studies directly or indirectly support NNWSI subtasks concerned with waste package design and geochemical modeling. To interpret the results of subtask experiments, it is necessary to know the exact nature of the starting material in terms of the intial bulk composition, mineralogy, and individual phase geochemistry. 31 figures, 5 tables.

24474 **(UCRL—53602) Transport properties of Topopah Spring tuff.** Lin, W.; Daily, W. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010448.

Electrical resistivity, ultrasonic P-waves velocity, and water permeability were measured simultaneously on both intact and fractured Topopah Spring tuff samples at a confining pressure of 5.0 MPa, pore pressures to 2.5 MPa, and temperatures to 140°C. The tested samples were subjected to three dehydration and rehydration cycles. The dehydrations were accomplished at a temperature of 140°C, and the rehydrations were accomplished at various combinations of temperature and pore pressures so that the wetting fluid was either liquid water, steam or both. The electrical resistivity measurements indicate that for the intact sample, the drying and resaturation took place fairly uniformly throughout the sample. On the other hand, for the fractured sample, the drying and resaturation was spatially quite nonuniform. When samples had been subjected to 5 MPa of confining pressure and 140°C for several weeks, a gradual monotonic drift in resistivity was measured (decreasing resistivity when dry; increasing resistivity when wet). This may be the result of either minerological changes or grain boundary movement. In any case, the phenomenon may have important consequences on long term repository performance, and should be studied further. The permeability of the intact sample was independent of temperature, dehydration and rehydration cycles, and time. The permeability of the fractured sample, initially dominated by the fracture, decreased by about one order of magnitude after each dehydration and rehydration cycle. 11 references, 12 figures, 3 tables.

24475 **(USGS-OFR—83-520) Availability of petrographic thin-sections from measured sections and wells in Early- to Late-Cretaceous Nanushuk Group rocks, National Petroleum Reserve in Alaska, North Slope, Alaska.** Bartsch-Winkler, S. (Geological Survey, Anchorage, AK (USA)). 1983. 10p. US Geological Survey Open File Services, Box 25245, Denver Federal Center, Denver, CO 80225. File Number TI85901329.

A collection of thin sections from rocks of the Early- to Late-Cretaceous Nanushuk Group, North Slope, are available for study. The thin sections are from measured sections collected in 1977 and 1978, and from wells drilled within the boundaries of the National Petroleum Reserve in Alaska. The thin sections which are predominantly sandstones, have been stained with sodium cobaltinitrite for potassium-feldspar and with alizarin red-s for calcite. They have been injected, under vacuum, with blue plastic dye in order to examine the pore space for diagenetic and porosity characteristics. The majority of the samples from measured sections have not undergone petrographic analysis. Details of the stratigraphy and locations of many of the surface samples, and discussions of the petrographic characteristics of the sandstones comprising selected measured sections have been reported in the literature cited in this report. Requests for specimen loans should be directed to: Irvin L. Tailleur, Office of National Petroleum Reserve in Alaska, US Geological Survey, M.S. 87, 345 Middlefield Road, Menlo Park, CA 94025. 16 references, 1 figure, 1 table.

24476 **Relationship of the degree of interconnection to permeability in fracture networks.** Long, J.C.S.; Witherspoon, P.A. (Earth Sciences Division, Lawrence Berkeley Laboratory, California). *Journal of Geophysical Research;* **90**: No. B4, 3087-3098(10 Mar 1985).

The problem of determining the permeability of a rock mass containing a system of finite fractures is highly dependent on both the degree of interconnection between fractures and the heterogeneity of individual fracture characteristics. This paper examines how degree of interconnection affects both magnitude and nature of the fracture permeability. The interconnection between given fracture sets is a complex function of (1) fracture density, i.e., the number of fractures per unit volume, and (2) the fracture extent or size. Unfortunately, neither the density nor the extent of fractures is easily determined from borehole data. However, fracture frequency can be directly measured in a borehole because it is simply the number of fractures intersected per unit length of the borehole. The frequency is a measure of the product of fracture density and size because the probability of a fracture intersecting a borehole is proportional to this product. The effect of the degree of interconnection was investigated by numerically simulating flow in fracture networks where fracture size and density varied inversely, while the product of these two parameters was held fixed. Directional permeabilities of a number of such networks were determined, and the hyraulic behavior of each fracture system was compared to that of an ideal porous medium. The permeability of the rock matrix between the fractures was assumed to be low enough to be negligible. The results show that as fracture length increases, the degree of interconnection increases. Thus, for a given fracture frequency as measured in a borehole, the permeability of the system increases as fracture length is increased, and density is proportionally decreased. Also, fracture systems with shorter, but more dense fractures behave less like porous media than do systems with longer but less dense fractures.

5804 Geochemistry

REFER ALSO TO CITATION(S) 23557, 24473

24477 **(USGS-CIRC—889) Lithium anomaly near Pringle, southern Black Hills, South Dakota, possibly caused by unexposed rare-mineral pegmatite.** Norton, J.J. (Geological Survey, Alexandria, VA (USA)). 1984. 10p. Geological Survey, 604 South Pickett St., Alexandria, VA 22304. File Number TI85900471.

Six samples of biotite schist from a site near Pringle, South Dakota, contained from 140 to 750 parts per million lithium. These values are far greater than are found in mica schists in most of the

rest of the southern Black Hills. The lithium may have emanated from concealed lithium pegmatite, and such pegmatite can be of interest as a possible source of rare minerals, especially tantalite and beryl. Whether making a full test of the anomaly will become economically judicious is much less clear. 18 refs., 2 figs., 2 tabs.

5805 Oceanography

REFER ALSO TO CITATION(S) 23581

24478 **Circulation induced by river inflow in well mixed water over a sloping continental shelf.** Csanady, G.T. (Woods Hole Oceanographic Institution, Woods Hole, MA 02543). *Journal of Physical Oceanography;* **14**: No. 11, 1703-1746(Nov 1984). Contract AC02-79EV10005.

The pressure field over a sloping continental shelf subject to freshwater runoff at the coast can be resolved into a nearly two-dimensional dynamic height field and a residual field, the latter arising from the interaction of baroclinity and topography. The residual field is essentially three-dimensional and so constituted as to supply the fluid for the baroclinic alongshore flow off a coastal source of buoyancy associated with the cross-isobath density gradients. The intensity of the induced residual circulation (its total transport in $m^3 s^{-1}$) varies directly with the buoyancy input and bottom slope, and inversely with the zero-order alongshore flow velocity and Coriolis parameter. Over the Mid-Atlantic Bight continental shelf the runoff-induced residual circulation makes a generally weak contribution to the observed mean flow field. It could, however, be more important over a low-latitude shelf subject to high runoff.

24479 **Calculation of ocean heat storage and effective ocean surface layer depths for the northern hemisphere.** Meehl, G.A. (National Center for Atmospheric Research, Boulder, Colorado 80307). *Journal of Physical Oceanography;* **14**: No. 11, 1747-1816(Nov 1984).

In the hierarchy of simple ocean formulations available for coupling to atmospheric GCMs, a scheme whereby ocean surface-layer depths vary geographically and seasonally is deemed better than a fixed depth layer at all locations and seasons, but still is less sophisticated than dynamic ocean models. Yet such simple ocean formulations are useful for basic sensitivity studies. Here, a calculation of varying surface layer depths is done by first performing an ocean heat storage calculation using gridded, long-term mean mixed-layer depths and sea surface temperatures with a parameterized temperature structure beneath the mixed layer derived from weather ship data. Heat storage values in the midlatitudes are larger in the Atlantic than in the Pacific, which is in qualitative agreement with the weather ship data. Variants of the basic calculation show that neither mixed layer dta nor SST data alone are sufficient to compute heat storage adequately. Using the results from the parameterized heat storage calculations, effective ocean surface-layer depths are computed. These are found to be deeper in the Atlantic than in the Pacific, with a strong semiannual monsoon signal apparent in the Indian Ocean. Since these calculations exclude the effects of vertical and horizontal motion further analysis as to the viability of these calculations can be done with the specified depths coupled to an atmospheric GCM.

64 PHYSICS. I.

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 24543, 24660, 24682, 24682, 24851, 24907

24480 **(FNAL/C—84/119-A) Dimensional reduction transition.** Kolb, E. (Fermi National Accelerator Lab., Batavia, IL (USA)). Nov 1984. Contract AC02-76CH03000. 6p. (CONF-8406234—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85003948.

From International symposium on phase transitions in the very early universe; Bielefeld, F.R. Germany (1 Jun 1984).

In this conference on phase transitions in the early Universe the author discusses the transition from more than four space-time dimensions to four effective space-time dimensions; the dimensional reduction transition. The basic assumption is that the true dimensionality of space-time is more than four, and that at present the extra dimensions are compact and too small to be observable. The origin of the observed gauge symmetries from symmetries of a compact space has been proposed as a possible approach for the unification of particle physics and gravity. The common assumption in all models with extra dimensions is that the unseen dimensions are compactified to a very small size, usually taken to be of the order of the Planck length. To probe the structure of the extra dimensions would require energies of the Planck mass E = m/sub pl/ = 1.2 x 10^{19}GeV, and the early Universe may be the only source of such energies. The author will assume for initial conditions that all spatial dimensions are small, and that initially the Universe had N = 3 + D spatial dimensions. When the temperature fell below T = R/sub D/$^{-1}$, where R/sub D/ is the physical size of the compact extra dimensions, the space-time dimensionality of the Universe underwent a reduction to effectively a 4 space-time dimensional Universe, and dynamical effects of the extra dimensions became unimportant. In this paper I will discuss three possible consequences of this cosmological dimensional reduction; entropy production (inflation), magnetic monopole production, and stable, massive particle production. 14 refs., 4 figs.

24481 **(FNAL/C—85/17-A) Cosmology in theories with extra dimensions.** Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1985. Contract AC02-76CH03000. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009536.

Some possible cosmological effects of the existence of extra compact dimensions are discussed. Particular attention is given to the possibility that extra dimensions might naturally lead to an inflationary Universe scenario.

24482 **(INPE—2672) Sub-second pulsations simultaneously observed at microwaves and hard X-rays in a solar burst.** Takakura, T.; Degaonkar, S.S.; Nitta, N.; Kaufmann, P.; Costa, J.E.R.; Ohki, N. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Nov 1982. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700515.

Sub-second time structures have been found in the emissions during solar bursts in mm-waves and, independently, in hard X-rays. However, simultaneous observations of such fast time structure in mm radio and X-ray ranges has not been available so far. Accordingly, coordinated observations of solar bursts in November 1981 with a high time resolution of a few milliseconds were planned. The hard X-rays (30-40 KeV were observed with hard X-ray monitor (HXM) aboard the Hinotori Satellite with a time resolution of 7.81 ms and the radio emissions were observed on the ground with 45ft dish at Itapetinga Radio Observatory with a high time resolution (1 ms) and high sensitivities at 22 GHz and 44 GHz, supplemented by a patrol observation at 7 GHz with time resolution of 100 ms. The pulsations repeated with a period of about 300 ms. The physical implication of the good correlation is not clear at this stage, but it may give a clue to the understanding of the high energy phenomena occuring during the solar flares.

24483 (INS-NUMA—44, pp 102-108) **Electron captures of neutron-rich nuclei and neutrino-trapping supernovae.** Takahara, Mariko (Tokyo Univ. (Japan). Coll. of General Education); Sato, Katsuhiko. Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

Effects of neutrino trapping on the mass ejection from stellar cores are investigated with the aid of a idealized equation of state under the assumption of adiabatic collapse. It is found that mass ejection becomes violent only if the ratio of the trapped leptons to baryons, Y sub(L), lies in an appropriate range. If the value of Y sub(L) lies out of this range, mass ejection is difficult. It is shown that as the thermal stiffness of the shocked matter increases, the range necessary for the violent mass ejection becomes wider. Possibilities of supernovae explosions are discussed on the base of these results.

24484 (INS-NUMA—44, pp 109-114) **Nuclei in neutrino-degenerate dense matter I: cold case.** Ogasawara, Ryusuke; Sato, Katsuhiko (Kyoto Univ. (Japan). Dept. of Physics). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

The properties of nuclei in cold dense matter with strongly degenerate neutrinos are investigated with the aid of an extended Thomas-Fermi model of nuclei. The following results are obtained. 1) The proton number of nucleus increases with the increasing density of the matter and it becomes very huge compared with that of the cold catalyzed matter due to the decrease of the Coulomb energy caused by the effect of the lattice-Coulomb energy. 2) The matter densities at the neutron-drip points, where the chemical potentials of neutrons equal zero are obtained as a function of the number of leptons per nucleon Y sub(L), and it is found that nuclei coalesce each other before neutron drip when Y sub(L) is greater than about 0.4 for the case of b.c.c. lattice. 3) Along the neutron-drip points, an infinite network of linked nuclei may be formed at the matter density rho sub(P) ~ 9 x 10^{13}g cm^{-3}, and the bubble-phase appears at the matter density rho sub(B) ~ 1.1 x 10^{14}g cm^{-3}. When the matter density becomes higher than rho sub(H) ~ 1.7 x 10^{14}g cm^{-3}, the bubbles melt into a homogeneous matter.

24485 (INS-NUMA—44, pp 115-130) **Explosive hydrogen and helium burning at constant pressures.** Hashimoto, Masaaki (Waseda Univ., Tokyo (Japan). Dept. of Physics); Hanawa, Tomoyuki. Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

We investigated nucleosynthesis under the conditions of constant pressures and "adiabatic" circumstances. Here, the notion of "adiabatic" circumstances implies that there are no heat in- or outflow from a mass element except associated neutrinos. Under such conditions nucleosynthesis during unstable hydrogen and helium burning is investigated using the nuclear reaction network involving 181 nuclear species (from ^{1}H to ^{82}Cu). Computations are made for the cases with log P (dyn cm^{-2}) over the range between 19 and 25. The result for explosive helium burning shows that the final abundances mainly consist of alpha-particle nuclei determined by pressure. The result for explosive hydrogen burning is that the products consist of unstable proton-rich nuclei near the proton-drip line which decay to stable nuclei ultimately.

24486 **(JINR—1-83-847) About one type of instability appearing during neutrino labelling.** Nedyalkov, I.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700837.

The problem about the accuracy of determining the $THETA_3$ angle at which the labelled neutrino flies out is considered. It turns out that in the vicinity of a certain critical value $THETA_3$ * the error with which this angle is calculated, grows sharply, that is the labelling process becomes unstable. It is shown that this special feature of labelled neutrinos should be taken into account, in particular, at neutrino experiments on the determination of the Earth structure.

24487 **(KGI—064) Observation of He+ ions in the solar wind.** Pissarenko, N.F.; Dubinin, E.M.; Zakharov, A.V.; Budnik, E.Yu.; Lundin, R. (Kiruna Geophysical Inst. (Sweden)). Feb 1984. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700894.

This paper describes results obtained from the PROGNOZ-8 ion composition experiment which indicates the He+ ions may be more abundant in the solar wind than previous measurements have indicated. The experiment has a sufficiently high mass resolution to accurately discriminate between H+, He++, He+ and O+ ions over the energy range 0.35-5.2 keV/e. Furthermore, the fact that the experiment is continuously monitoring in the solar direction means that fairly good statistics can be aquired as well. In a few cases, He+/He++ ratios up to ca 0.05 have been found, but in most cases when He+ was observed, it was generally of the order 0.3-3 percent of the He++ content. We compared our results with previous measurements of He+ ions in the solar wind and discuss also other constituents with M/q equal with 4 as alternative candidates. Finally, a possible explanation for the high He+ abundance in the disturbed solar wind is given.

24488 **(N—85-15536) IRAS galaxy 0421+040P06: an active spiral ( ) galaxy with extended radio lobes.** Beichman, C.A.; Wynn-Williams, C.G.; Lonsdale, C.J.; Persson, S.E.; Heasley, J.N.; Miley, G.K.; Soifer, B.T.; Neugebauer, G. (Jet Propulsion Lab., Pasadena, CA (USA)). Aug 1984. 30p. (NASA-CR—174208). NTIS, PC A03/MF A01.

The infrared bright galaxy 0421+040P06 detected by IRAS at 25 and 60 microns was studied at optical, infrared, and radio wavelength. It is a luminous galaxy with apparent spiral structure emitting 4 x 10 to the 37th power from far-infrared to optical wavelengths. Optical spectroscopy reveals a Seyfert 2 emission line spectrum, making 0421+040P06 the first active galaxy selected from an unbiased infrared survey of galaxies. The fact that this galaxy shows a flatter energy distribution with more 25 micron emission than other galaxies in the infrared sample may be related to the presence of an intense active nucleus. The radio observations reveal the presence of a non-thermal source that, at 6 cm, shows a prominent double lobed structure 20 to 30 kpc in size extending beyond the optical confines of the galaxy. The radio source is three to ten times larger than structures previously seen in spiral galaxies.

24489 **(N—85-15537) Unidentified IRAS sources: ultra-high luminosity galaxies.** Houck, J.R.; Schneider, D.P.; Danielson, G.E.; Beichman, C.A.; Lonsdale, C.J.; Neugebauer, G.; Soifer, B.T. (Jet Propulsion Lab., Pasadena, CA (USA); Cornell Univ., Ithaca, NY (USA)). 1985. 18p. (NASA-CR—174207). NTIS, PC A02/MF A01.

Optical imaging and spectroscopy measurements were obtained for six of the high galactic latitude infrared sources reported by Houck, et al. (1984) from the IRAS survey to have no obvious optical counterparts on the POSS prints. All are identified with visually faint galaxies that have total luminosities in the range 5 x 10 to the 11th power stellar luminosity to 5 x 10 to the 12th power stellar luminosity. This luminosity emerges virtually entirely in the infrared. The origin of the luminosity, which is one to two orders of magnitude greater than that of normal galaxies, is not known at this time.

24490 **(N—85-15539) Local Interstellar Medium. International Astronomical Union Colloquium No. 81.** Kondo, Y.; Bruhweiler, F.C. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Nov 1984. 356p. (NASA-CP—2345). NTIS, PC A16/MF A01.

Helium and hydrogen backscattering, ultraviolet and EUV absorption spectra, optical extinction and polarization, hot gases, soft X-ray observations, infrared and millimeter wavelengths, radio wavelengths and theoretical models of the interstellar matter within about 150 parsecs of the Sun were examined.

24491 **(N—85-15540) Helium and hydrogen of the Local Interstellar Medium observed in the vicinity of the Sun.** Bertaux, J.L. (Centre National de la Recherche Scientifique, 91 - Verrieres-le-Buisson (France)). Nov 1984. 21p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 3-23p. (N—85-15539 0690).

The Sun illuminates the hydrogen and helium atoms of the interstellar medium through which it travels. As a result, the Sun and the whole solar system are imbedded in a glow of the resonance lines of hydrogen (H Lyman alpha 121.6nm) and helium (58.4nm). From the intensity distribution of the glow in the solar system, the density of H and He in the Local Interstellar Medium (LISM) and the direction of the relative motion between the Sun and the LISM in the vicinity of the Sun are derived. The velocity module and the LISM temperature are more adequately found from a measurement of the Lyman alpha line shape, which is an image of

the velocity distribution of H atoms. The result is summarized and together the methods of interpretation and difficulties are dicussed.

24492 **(N—85-15542) Changes of LISM characteristics in the heliospheric interface.** Ripken, H.W.; Fahr, H.J. (Bonn Univ. (Germany, F.R.)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 29-31p. (N—85-15539 06-90).

The LISM properties can be deduced from observations of interstellar neutral gases in the inner solar system. Parameters accessible by this method are the interstellar wind vector and the densities and temperatures of hydrogen and helium, implying also the deduction of the relative abundance ratios and the degree of ionization in the LISM. Direct inference from observations, for example resonance luminescence measurements of Ly-alpha and He-58.4 nm radiation, yields values appropriate only for the inner solar system, i.e. for the regions within the heliopause dominated by the solar wind plasma. Particularly the subsonic LISM plasma interface ahead of the heliopause causes profound changes in the properties of the neutral LISM gas traversing this region. Mainly p-H charge exchange processes give rise to the destruction of primary hydrogen and the production of secondary hydrogen atoms, the net effect being a depletion of the neutral hydrogen component of the LISM by about 50%. Details on the depletion mechanisms, the hydrogen and oxygen extinctions, and the consequences for the Ly-alpha resonance luminescence intensity interpretations are presented.

24493 **(N—85-15543) Broadening of the interplanetary helium cone structure due to elastic collisions of LISM helium atoms with solar wind ions.** Fahr, H.J.; Nass, H.U.; Rucinski, D. (Bonn Univ. (Germany, F.R.)). Nov 1984. 6p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 32-37p. (N—85-15539 06-90).

Neutral interstellar particles penetrating into the heliosphere, besides being subject there to specific loss processes, suffer elastic collisions with KeV-solar wind ions. The momentum transfer to the neutrals connected with these collisions leads to a loss of angular momentum with respect to the Sun and to a fractional compensation of the effective solar gravity. The dynamical particle trajectories hence are changed into non-Keplerians leading to density and temperature distributions differing from those calculated in the past. This is found from a solution of the Boltzmann equation that linearizes the effect of this additional force. It is shown that the HeI-584A resonance glow of the heliospheric helium cone lead to substantially lower interstellar helium temperatures if re-interpreted on the basis of this revised theory. These temperatures now seem to be in accordance with the derived temperatures for interstellar hydrogen.

24494 **(N—85-15544) Absorption line studies and the distribution of neutral gas in the Local Interstellar Medium.** Bruhweiler, F.C. (Catholic Univ. of America, Washington, DC). Nov 1984. 12p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 39-50p. (N—85-15539 06-90).

Previous published absorption line studies performed at ultraviolet and visual wavelengths are combined with new ultraviolet data in order to map out the distribution of HI within 150 pc of the Sun. Newly presented data for distances less than 50 pc further support the local cloud model as presented by Bruhweiler (1982). The Sun is embedded, near the edge of a diffuse cloud with total column density 2 x 10 to the 19th power/sq cm. Most observed directions within 50 pc away from the cloud body reveal trace amounts of gas N(HI) approximately 10 to the 18th power/sq cm presumably arising in the outer skin of the local cloud. At greater distances (50 approximately or d approximately or 150 pc) most directions show significant absorption with N(HI) 10(19)/sq cm. Two directions, one toward the northern galactic pole (NGP), the other toward beta CMa exhibit unusually low HI column densities out to distances of 150 to 200 pc. However, substantial amounts of gas N(HI) 10 to the 19th power/sq cm, are seen toward the NGP at greater distances. The implicatons of these results on astronomy at wavelengths shortward of 912A are discussed.

24495 **(N—85-15545) Synthesis of data on the Local Interstellar Medium.** York, D.G.; Frisch, P.C. (Chicago Univ., IL (USA)). Nov 1984. 9p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 51-59p. (N—85-15539 06-90).

While no completely definitie picture of the Local Interstellar Medium can be presented yet, some general conclusions can be drawn. New UV results are collated with published results to help state the physical properties of the gas. A morphological view of the local medium is given.

24496 **(N—85-15546) Observations of interstellar HI toward nearby late-type stars.** Landsman, W.B.; Henry, R.C.; Moos, H.W. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Nov 1984. 3p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 61-63p. (N—85-15539 06-90).

High-disperson Copernicus and IUE observations of chromospheric Ly alpha emission are used to study the distribution of HI in the Local Interstellar Medium. Interstellar parameters are derived toward 3 stars within 5 pc of the Sun, and upper limits are given for the Ly alpha flux from 9 other stars within 10 pc.

24497 **(N—85-15547) Observations of local interstellar Mg I and Mg II.** Bruhweiler, F.C.; Oegerle, W.; Weiler, E.; Stencel, R.; Kondo, Y. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Nov 1984. 3p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 64-66p. (N—85-15539 06-90).

Copernicus and IUE observations of 5 stars within 50 pc of the Sun were combined to study the ionization of magnesium in the Local Interstellar Medium (LISM). The high resolution Copernicus spectrometer was used to detect interstellar MG I 2852 in the spectra of alpha Gru, alpha Eri, and alpha Lyr, while placing upper limits on Mg I in the spectra of alpha CMa and alpha PsA. Observations of Mg II 2795, 2802 for these stars were also obtained with IUE and Copernicus. The column densities of Mg I and Mg II are used to place constraints on the temperature of the LISM.

24498 **(N—85-15548) Mg II spectra of late type stars used to probe the LISM.** Beckman, J.E.; Crivellari, L.; Franco, M.L.; Molaro, P. (Queen Mary Coll., London (UK)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 67-70p. (N—85-15539 06-90).

IUE spectra of Mg II h and k in late type dwarfs and giants were used to detect and measure absorption components due to the LISM. This technique gives a method of probing the awkward range from d 3 pc to d 80 pc from the Sun. In spite of interpretational uncertainties the HI component of the LISM can be plotted well enough to confirm it as a cloud some 20 to 30 pc in extent, peaking sharply in density towards l(II)-25 deg., moving towards the Sun from l(II)-25 deg, b(II) + 10 deg., at 28 Km/sec. The hole towards l(II) 150 deg is confirmed, suggesting a solar position close to the cloud's edge in this direction.

24499 **(N—85-15549) FeII and MgII in the nearby interstellar medium.** Deboer, K.S.; Lenhart, H. (Tuebingen Univ. (Germany, F.R.)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 71-74p. (N—85-15539 06-90).

Ultraviolet spectra with 15 km/s resolution of bright stars were searched for FeII and MgII interstellar lines. Equivalent widths of absorption for 8 stars are presented and average line-of-sight densities n(FeII) 4 x 10(-8) and n(MgII) 2 x 10(-7)/cubic cm are calculated. This represents approximately n(H) 0.03/cu cm.

24500 **(N—85-15550) Type stars as probes of the Local Interstellar Medium.** Ferrero, R.F.; Ferlet, R. (Observatoire de Strasbourg (France)). Nov 1984. 6p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 75-80p. (N—85-15539 06-90).

With the aim to sample the Local Interstellar Medium (LISM), it was proposed to use A stars as targets. The Mg II UV lines seem to be the best interstellar absorption candidates. Several hundreths of A stars can be reached within 100 pc. First preliminary results (20 lines of sight) are presented, based on previous Copernicus and actual IUE observations.

24501 **(N—85-15551) Probe of the nearby interstellar medium by the vacant line of sight to Beta CMa.** Gry, C.; York, D.G. (European Space Agency, Madrid (Spain). ESA Tracking Station). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 80-83p. (N—85-15539 06-90).

The line of sight to Beta CM a was probed by Copernicus observations. This particular line of sight is remarkable for the low mean densities. The density was found to be bar N sub H approximately .002/cu cm. Two separate regions were distinguished: (1) A local nearby HI region extends over a few parsecs from the Sun with a density of the order of 0.1/cu cm and a temperature of 11000 to 12500 K and (2) An HII region lies somewhere beyond the HI region and is spread over about 60pc. Its total hydrogen mean density is of the same order as the HI region, i.e., of approximately 0.1 cu cm and it contains only elements in low ionization state. All the ata are coherent with the picture of a cloud in ionization equilibrium at T approximately 23000 deg K.

24502 **(N—85-15552) Deuterium abundance in the Local Interstellar Medium.** Ferlet, R.; Gry, C. (Centre National de la Recherche Scientifique, 75 - Paris (France). Inst. d'Astrophysique). Nov 1984. 5p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 84-88p. (N—85-15539 06-90).

The present situation of deuterium abundance evaluation in interstellar space is discussed. It can be shown that the D/H evaluation made toward lambda Sco is in fact related to the Local Interstellar Medium (less than 10 pc from the Sun). The deuterium abundance in the Local Interstellar Medium varies by at least a factor of two over few parsecs.

24503 **(N—85-15553) IUE observations of the gaseous component of the Local Interstellar Medium.** Gilra, D.P. (S and M Systems and Research Corp., Lanham, MD (USA)). Nov 1984. 2p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 89-90p. (N—85-15539 06-90).

Discovery of interstellar Ge, Ga, and Kr is reported. Several intercombination lines of Fe 2 are detected. The depletion is most pronounced in Ca, Ti, and V. The highly ionized gas C 4 and Si 4 is not co-extensive with the Si 2 and C 2 gas nor with the O 6 gas. The molecular gas (CO) shows very small velocity dispersion (b approximately 1 km/sec). HD 149404 has the richest interstellar spectrum (except molecules) of all the stars in this study. HD 147889, the heavily obscured star in the Rho Oph cloud, has the strongest interstellar CO spectrum. Noisy nature of the spectra precludes detection of other molecules.

24504 **(N—85-15554) Voyager EUV and FUV observations.** Holberg, J.B. (Arizona Univ., Tucson (USA)). Nov 1984. 5p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 91-95p. (N—85-15539 06-90).

The Voyager 1 and 2 ultraviolet spectrometers are sensitive over the wavelength range 500 to 1700 A. In the extreme ultraviolet (EUV), at wavelengths shortward of the Lyman limit (912 A), Voyager observations detected emission from three out of a sample of 11 nearly hot DA white dwarfs. These observations imply very low HI column densities in the directions of the three stars detected. In the far ultraviolet (FUV), at wavelengths between 912 and 1200 A, Voyager observations of O and B stars can be used to study interstellar reddening at the shortest wavelengths and to provide useful estimates of interstellar H2 column densities.

24505 **(N—85-15555) Optical emission line studies and the warm, ionized component of the Local Interstellar Medium.** Reynolds, R.J. (Wisconsin Univ., Madison (USA)). Nov 1984. 12p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 97-108p. (N—85-15539 06-90).

Observations of diffuse, galactic H alpha, N2 lambda 6583, and S2 6716 emission lines provide evidence for a warm (10,000K), primarily ionized component of the interstellar medium distribution throughout the galactic disk. This component of the interstellar gas has an electron density approximately equals 0.1-0.2/cu cm and occupies about 10 to 30% of the interstellar volume. Interstellar H alpha emission near the galactic poles, the dispersion measure of a nearby pulsar, and observations of interstellar gas flowing into the solar system indicate that this ionized component is an important constituent of the interstellar medium in the solar neighborhood. The intensity of the H alpha background at high galactic latitudes implies that this component is maintained by an average hydrogen ionization rate in the vicinity of the Sun of (2-4) x 100,000 s(-1) per square cm of galactic disk. The emission measure is 1.3 to 2.3 cm (-6) pc toward the galactic poles. The sources of this ionization were not identified but may include escaping Lyman continuum radiation from planetary nebulae, hot white dwarfs, and early type stars.

24506 **(N—85-15556) High-resolution study of local interstellar sodium.** Ardeberg, A.; Lindgren, H.; Maurice, E. (Observatoire de Marseille, 13 (France)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 109-112p. (N—85-15539 06-90).

A high-resolution spectroscopic investigation was made of interstellar lines of sodium. From identifications of D1 and D2 line components concentrations of interstellar sodium gas were studied. Some preliminary data are provided on the spatial distribution of stronger sodium concentrations.

24507 **(N—85-15557) Optical observations of nearby interstellar gas.** Frisch, P.C.; York, D.G. (Chicago Univ., IL (USA)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 113-116p. (N—85-15539 06-90).

Observations indicated that a cloud with a heliocentric velocity of approximately -28 km/s and a hydrogen column density that possibly could be on the order of, or greater than, 5 x 10 to the 19 power/square cm is located within the nearest 50 to 80 parsecs in the direction of Ophiuchus. This is a surprisingly large column density of material for this distance range. The patchy nature of the absorption from the cloud indicates that it may not be a feature with uniform properties, but rather one with small scale structure which includes local enhancements in the column density. This cloud is probably associated with the interstellar cloud at about the same velocity in front of the 20 parsec distant star alpha Oph (Frisch 1981, Crutcher 1982), and the weak interstellar polarization found in stars as near as 35 parsecs in this general region (Tinbergen 1982). These data also indicate that some portion of the -14 km/s cloud also must lie within the 100 parsec region. Similar observations of both Na1 and Ca2 interstellar absorption features were performed in other lines of sight. Similar interstellar absorption features were found in a dozen stars between 20 and 100 parsecs of the Sun.

24508 **(N—85-15558) Distances of local clouds from optical line observations.** Crutcher, R.M.; Lien, D.J. (Illinois Univ., Urbana (USA)). Nov 1984. 5p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 117-121p. (N—85—15539 06-90).

The interstellar D-line of Na 1 toward 49 stars were observed in order to determine the distance (125 plus or minus 25 pc) to a cold H 1 cloud. This sheet of gas may be part of the back side of the shell formed by the Loop I supernova.

24509 **(N—85-15559) Local interstellar extinction with an emphasis on uvby beta results.** Knude, J. (Copenhagen Observatory (Denmark)). Nov 1984. 22p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 123-144p. (N—85-15539 06-90).

Some theories concerning the distribution of interstellar dust are surveyed. Average reddening and the distribution of local dust

studied by means of ultraviolet photometry are discussed. The existence of local dust in the pole directions, local voids, variations of color excess with distance, and properties of local diffuse dust clouds are among the topics considered.

24510 **(N—85-15561) Arching HI filaments show in local reddening data.** Knude, J. (Copenhagen Observatory (Denmark)). Nov 1984. 5p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 149-153p. (N—85-15539 06-90).

Probable dust counterparts of arching structures are investigated in two cases: (1) the Eridanus expanding shell; and (2) the extended Sco-Cen feature. Color excess data may be used to derive distance and dimension estimates of these structures. Color excesses from two areas SA 121 and SA 144 situated on the position of the 3.2 to 6.3 km/s velocity-slice are applied. Some stratification of the color excesses is noticed for both areas but extreme patchiness typifies particularly the dust in the SA 144 region.

24511 **(N—85-15562) Observations of absorption lines from highly ionized atoms.** Jenkins, E.B. (Princeton Univ., NJ (USA). Observatory). Nov 1984. 14p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 155-168p. (N—85-15539 06-90).

In the ultraviolet spectra of hot stars, absorption lines can be seen from highly ionized species in the interstellar medium. Observations of these features which have been very influential in revising the perception of the medium's various physical states, are discussed. The pervasiveness of O 6 absorption lines, coupled with complementary observations of a diffuse background in soft X-rays and EUV radiation, shows that there is an extensive network of low density gas (n approx. fewX 0.001/cucm) existing at coronal temperatures, 5.3 or log T or 6.3. Shocks created by supernova explosions or mass loss from early-type stars can propagate freely through space and eventually transfer a large amount of energy to the medium. To create the coronal temperatures, the shocks must have velocities in excess of 150 km/sec; shocks at somewhat lower velocity 9v or 100 km/sec can be directly observed in the lines of Si3. Observations of other lines in the ultraviolet, such as Si 4V and C 5, may highlight the widespread presence of energetic ov radiation from very hot, dward stars. More advanced techniques in visible and X-ray astronomical spectroscopy may open up for inspection selected lines from atoms in much higher stages of ionization.

24512 **(N—85-15565) Observations of highly-ionized interstellar iron.** Hobbs, L.M. (Yerkes Observatory, Williams Bay, WI (USA)). Nov 1984. 5p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 189-193p. (N—85-15539 06-90).

The spectra of 24 stars, including 5 at distances d 200 pc, have been observed in the regions of the coronal Fe X lambda 6375 and Fe X lambda 5303 lines at detection limits near an equivalent width of 1 mA in the best cases. In general agreement with predictions based on a multi-phase model of the interstellar medium, no absorption which can be attributed to Fe X or Fe X4 ions in hot interstellar gas emitting the soft X-ray background is seen in any of these spectra, except for two. Toward lambda Cephei an absorption line near lambda 6375 is measured with an equivalent width of 8.1 + or - 2 mA, a width corresponding to 20 + or - 5 km/sec or a temperature T or (0.5 + or - 0.25) x 10 to the 6th power K, and, if it is caused by Fe X ions, a radial velocity of -355 km/sec. On that hypothesis, the interstellar gas constitutes at least 63% of the column density of gas along this light path.

24513 **(N—85-15566) Soft X-ray diffuse background: implications for the nature of the Local Interstellar Medium.** Mccammon, D. (Wisconsin Univ., Madison (USA)). Nov 1984. 9p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 195-203p. (N—85-15539 06-90).

Observations of the diffuse X-ray background in the B and C bands (130-188 eV and 160-284 eV, respectively) provide convincing evidence for the existence of high-temperature interstellar gas. Since the opacity of normal interstellar material is very high, it is assumed that the soft X-ray flux observed in the galactic plane originates within a few hundred parsecs of the Sun. The intensity and B/C ratio of this low-latitude flux can be provided by emission from an equilibrium plasma with normal abundances, T 10 to the 6th power K, and 0.0019 cm(-6) pc emission measure. More sophisticated nonequilibrium models of material heated by a supernova blast wave would reduce the required emission measure somewhat, but not by so much as a factor of two. Arbitrarily limiting the pressure to 10 to the 4th power cm(-3) K gives a maximum density of 0.005 cm(-3) and a minimum radius for the emitting region of 75 pc. This fits in well with ultraviolet interstellar absorption measurements which indicate that the interstellar medium is very deficient in neutral hydrogen out to approx. 100 pc from the Sun.

24514 **(N—85-15567) Non-local origin of a substantial portion of the soft X-ray background.** Clark, G.W. (Massachusetts Inst. of Tech., Cambridge (USA)). Nov 1984. 7p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 204-210p. (N—85-15539 06-90).

Comparison of the SAS-3 soft X-ray sky survey with the 21-cm neutral hydrogen survey confirms the well-known anticorrelation between the counting rates in the C-band (0.10-0.28 keV) and the column density of neutral hydrogen, and demonstrates that this anticorrelation is significant on all angular scales ranging from that of the general trend from the galactic equator to the poles down to the angular resolution of the detector (2.07 FWHM). Numerous instances of what appear to be soft X-ray shadows of nearly (100-300 pc) 21-cm features, and several bright X-ray regions coincident with holes in the interstellar medium are included in this general correlation. The final set of selected data has an exposure of 2.2 x 10 to the 4th power/sq cm s sr, a sky coverage of 80%, and is free of spurious effects due to charged particles and solar radiations. The validity of the two-component model of the X-ray background introduced by Davidsen et al. (1977) is examined. In this model the C-band intensity in a given direction is represented as a sum of a constant term, I sub 1, due to unattenuated emission from a local hot bubble in which the solar system is immersed, and a term, I sub 2 exp (N sub H sub th) , due to emission from a diffuse source beyond the neutral hydrogen 2.g., the galactic corona).

24515 **(N—85-15568) Nature of the soft X-ray emitting region in the direction of the North Polar spur.** Morrison, J.P.; Sanders, W.T. (Wisconsin Univ., Madison (USA)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 211-214p. (N—85-15539 06-90).

The spatial structure of the X-ray sky in the direction of the North Polar Spur was examined in two energy bands, the B band (0.10 to 0.18 keV) and the C band (0.15 to 0.28 keV). A model with two emitting regions, one local with unabsorbed emission, and the other more distant with emission partially absorbed by spatially varying amounts was investigated. Using the distribution of atomic hydrogen as a measure of absorbing material, this model was used to predict the flux in the direction of the North Polar Spur. The predicted flux was compared to the data obtained from several sounding rocket flights. The derived flux was found to correlate well with the observed data.

24516 **(N—85-15569) Local contributions to the 0.6 keV diffuse X-ray background.** Burrows, D.N. (Pennsylvania State Univ., University Park (USA)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 215-218p. (N—85-15539 06-90).

The intensity of the X-ray background between 0.5 and 1.0 keV has surprisingly little dependence on galactic latitude. Possible mechanisms for the production of these X-rays include extragalactic emission and emission from dM stars, both of which should be strongly dependent on galatic latitude, and diffuse emission from hot gas (T approx. 3 x 10 to the 6th power K) surrounding the Sun. These mechanisms can be distinguished by the presence or absence of absorption by gas within a few hundred parsecs of the Sun. X-ray data from the HEAO-1 LED detectors and H1 data from the recent Crawford Hill 21 cm survey are used to place limits on the

0.6 keV intensity originating within 300 pc of the Sun in the general direction of (lambda,b) (150 deg - 30 deg).

24517 **(N—85-15570) HEAO-1 diffuse soft X-ray sky maps.** Nousek, J.A.; Garmire, G.P.; Weaver, G. (Pennsylvania State Univ., University Park (USA)). Nov 1984. 3p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 219-221p. (N—85-15539 06-90).

Maps of the diffuse X-ray background intensity are presented, spanning four energy intervals. The lowest energy interval (0.18 to 0.56 keV) is dominated by local emission, while the next two intervals (0.56 to 1.0 keV and 1.0 to 1.4 keV) reveal more distant and more sharply defined structures. Enlarged maps of several of these structures are presented, including the North Polar Spur, the Galactic Center region and the Eridanus Loop.

24518 **(N—85-15571) Ultrasoft X-ray background observations of the Local Interstellar Medium.** Sanders, W.T.; Snowden, S.L.; Bloch, J.J.; Juda, M.; Jahoda, K.M.; Mccammon, D. (Wisconsin Univ., Madison (USA)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 222-225p. (N—85-15539 06-90).

Preliminary results from a May 8, 1984 sounding rocket survey of the soft X-ray background are presented. The X-ray detectors are sensitive to X-rays in three soft X-ray bandpasses: 80 to 110 eV, 90 to 188 eV, and 284 to 532 eV (at 20% of peak response). The lowest energy X-rays in this range have a mean free path of order 10 to the 19th power/sq cm and provide information about the Local Interstellar Medium. The count rate in the 80 to 110 eV energy band (the Be band) tracks the 90 to 188 (eV band (the B band) very well, indicating that the same approx. 1 million degree gas that is responsible for the B band emission may be responsible for the bulk of the Be band X-rays as well.

24519 **(N—85-15573) Molecular clouds within 100 pc.** Blitz, L.; Magnani, L.; Mundy, L. (Maryland Univ., College Park (USA)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 231-234p. (N—85-15539 06-90).

Observations at the 2.6 mm line of CO reveal the presence of a large number of molecular clouds at high galactic latitude. If the velocity dispersion of the clouds is a measure of their scale height, the mean distance of the ensemble detected is 100 pc. The clouds are unusual in that either they are not gravitationally bound or they are very deficient in CO relative to molecular hydrogen. These clouds represent a heretofore unrecognized component of the local interstellar medium. If they are pervasive in the Milky Way, they probably represent the small molecular cloud component of the interstellar medium.

24520 **(N—85-15574) Wide latitude CO survey of molecular clouds in the northern Milky Way.** Dame, T.M.; Thaddeus, P. (National Aeronautics and Space Administration, New York (USA). Goddard Inst. for Space Studies; Columbia Univ., New York (USA)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 235-238p. (N—85-15539 06-90).

It is now well established that molecular clouds are an important part of the interstellar medium, containing much or most of the dense, cold component of the gas, and producing the massive stars and supernovae responsible for the diffuse, hot component. It would therefore appear essential in formulating a complete picture of the local interstellar medium to have some knowledge of the distribution and properties of nearly molecular clouds. The Goddard-Columbia 1.2 meter telescope was used to carry out a wide latitude, low angular resolution survey of CO along most of the first galactic quadrant and a small part of the second. A plane-of-the-sky map, which resulted from numerically integrating the survey over radial velocity, is presented. The Great Rift and the Aquila Rift molecular clouds of the Milky Way are discussed.

24521 **(N—85-15576) Neutral gas jet in a low velocity shock front at the boundary of the Draco Nebula.** Kalberla, P.W.M.; Herbstmeier, U.; Mebold, U. (Bonn Univ. (Germany, F.R.)). Nov 1984. 5p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 243-247, (N—85-15539 06-90).

Twenty-one cm line observations with the Westerbork Synthesis Radio Telescope of a dust and molecular filament at the boundary of the Draco Nebula reveal a jet like neutral hydrogen feature funneling through an outlet in the low velocity shock front at the interface between the Draco Nebula and the surrounding gas. The jet like feature is apparently connected with a high velocity filament at VLSR -180 km/sec. It is suggested that soft X-ray emission observed in the area is thermal bremsstrahlung produced by the deceleration of high velocity gas in galactic gas.

24522 **(N—85-15577) Draco Nebula, a molecular cloud associated with a high velocity cloud.** Mebold, U.; Kalberla, P.W.M. (Bonn Univ. (Germany, F.R.)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 249-252p. (N—85-15539 06-90).

Extended and very faint bright nebulae are found in high galactic latitudes at the Palomar Observatory Sky Survey. Such a nebula, located in the constellation Draco and called Draco Nebula or Dracula, was found to be in detailed positional coincidence with a 21 cm emission line feature. Estimates of the minimum visual extinction from star counts ON and OFF Dracula and an estimated visual surface brightness indicate that Dracula fits the relation SBV 24.2 - 2.5 log AV for dust clouds located above the galactic plane and reflecting the integrated starlight of the galactic disk. Hence Dracula is probably a reflection nebula. Indicators of molecular hydrogen in Dracula, molecules such as CO, were searched for by using a 2.5-m mm-telescope. Molecular hydrogen column densities were estimated. The dynamics of CO clumps was studied. Dracula has a close positional and possibly even astrophysical relationship to the high velocity cloud phenomenon.

24523 **(N—85-15578) Smallest sizes of diffuse interstellar clouds.** Dickey, J.M.; Crovisier, J.; Kazes, I. (Minnesota Univ., Minneapolis (USA)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 258-262p. (N—85-15539 06-90).

By observing the difference in optical depths between absorption spectra toward the two components of double sources, the variations in opacity over lengths of less than 0.1 up to 10 pc inside diffuse interstellar clouds were measured. Significant variations were detected on scales larger than about 0.2 pc, but not less. This may represent the minimum size for diffuse cloud structure. By comparing the variations of Gaussian fitted line parameters, it was found that variations in the internal velocity field of diffuse clouds explain the data better than tiny independent cloudlets.

24524 **(N—85-15579) Warm magnetoactive plasma in a large volume of space.** Heiles, C. (California Univ., Berkeley (USA)). Nov 1984. 6p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 263-268p. (N—85-15539 06-90).

A diffuse ionized warm gas fills a large volume of space in the general direction of Radio Loop II. There are three types of observational evidence: Faraday rotation measures (RM's) of extragalactic sources; emission measures (EM's) derived from the H alpha emission line in the diffuse interstellar medium; and magnetic field strengths in HI clouds derived from Zeeman splitting observations.

24525 **(N—85-15580) Z-dependence of the spin temperature of H1.** Kulkarni, S.R.; Heiles, C. (California Univ., Berkeley (USA)). Nov 1984. 5p. NTIS, PC A16/MF A01.

Results relating to the following aspects of hydrogen clouds are presented: (1) the vertical distribution of cold H1 clouds; (2) possible systematic warming of H1 clouds at high absolute values of z; (3) possible increase of the fraction of warm intercloud

medium H1 with high absolute values of z; and (4) the effect of optical depth on previous H1 emission surveys.

24526 **(N—85-15581) Polarization of radio molecular lines and mapping of magnetic field direction.** Deguchi, S.; Watson, W.D. (Illinois Univ., Urbana (USA)). Nov 1984. 2p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 274-275p. (N—85-15539 06-90).

Two level calculations by others for the linear polarizations expected for molecular emission lines from interstellar clouds are extended by considering a number of coupled rotational states of a diatomic molecule. Higher transitions commonly have strengths comparable with that of the J 1-0 transition so that depolarization due to coupling between the various J states might be expected to reduce the predicted linear polarization. The significance of the null observational results obtained recently by Wannier, Scoville, and Barvainis is assessed. The inclusion of additional states tends to decrease the maximum polarizations, though the calculated polarization is increased under conditions for which superthermal excitation occurs.

24527 **(N—85-15582) Nearby molecular hydrogen.** Lebrun, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Nov 1984. 3p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 277-279p. (N—85-15539 06-90).

If the gas-to-dust ratio is sufficiently uniform throughout the Local Interstellar Medium, galaxy counts may provide a useful probe of the large scale structure of the interstellar gas. This idea substantiated by gamma ray observations led to the discovery of nearby molecular cloud complexes. The reddening studies indicate that one of them lies between 80 and 140 pc from the Sun. From CO observations, its molecular mass is estimated to be a few 1000 stellar mass units.

24528 **(N—85-15583) Radio and UV observations of high latitude HI.** Lockman, F.J.; Hobbs, L.M. (National Radio Astronomy Observatory, Socorro, NM (USA)). Nov 1984. 1p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 290p. (N—85-15539 06-90).

Interstellar Lyman alpha observations toward high latitude stars, which give the column density of H I between Earth and the star, and 21 cm radio observations, which give the total H I column density to and beyond the star, can be combined to map out the amount of neutral gas as a function of distance from the Sun. Observations of the 21 cm and Lyman alpha lines made toward approximately 50 high latitude OB stars are presented. These data are used to discuss the distribution of H I in the solar neighborhood.

24529 **(N—85-15584) Parallax of pulsar 0950+08 and the local free electron density.** Gwinn, C.R.; Taylor, J.H.; Weisberg, J.M.; Rawley, L.A. (Princeton Univ., NJ (USA)). Nov 1984. 3p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 281-283p. (N—85-15539 06-90).

A parallax of 7.9 + or - 0.8 mas for PSR 0950+08, corresponding to a distance of 130 + or - 15 pc is reported. The measured pulse dispersion of this pulsar implies an average free electron density of 0.023 + or 0.002/cu cm along the line of sight. This parallax measurement is subject to systematic errors and questions of interpretation which are not yet fully explored.

24530 **(N—85-15585) Modelling the Local Interstellar Medium as a supernova remnant in a multiphase gas.** Cowie, L.L. (Massachusetts Inst. of Tech., Cambridge (USA)). Nov 1984. 10p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 287-296p. (N—85-15539 06-90).

The construction of supernova remnant which is consistent with the observations and what it talls about the theory was investigated. It is argued that thermal evaporation and local inhomogeneity are crucial elements which are essential to any satisfactory description. It is concluded that: (1) a multiphase supernova remnant (SNR) seems to provide a plausible description of the Local Interstellar Medium (ISM); (2) the local region could have been deficient in cool gas prior to the supernova both on theoretical and observational grounds; (3) the Sun may lie in a region towards the outside of the supernova remnant which hasn't yet come into pressure equilibrium with the hot gas; and (4) evaporative models give a much more satisfactory description of the O VI observations than Sedov Solutions.

24531 **(N—85-15586) Model of the soft X-ray background as a blast wave viewed from inside.** Edgar, R.J.; Cox, D.P. (Wisconsin Univ., Madison (USA)). Nov 1984. 4p. NTIS, PC A16/MF A01.

In NASA, Goddard Space Flight Center, Local Interstellar Medium, No. 81, 297-300p. (N—85-15539 06-90).

The suggestion that the soft X-ray background arises in part from the Sun which is inside a large supernova blast wave was examined by models of spherical blast waves. The models can produce quantitative fits to both surface brightnesses and energy band ratios when t 10 to the 5th power E sub o 5 x 10 to the 50th power ergs, and n sub approx. 0.004 cm to the -3 power. The models are generalized by varying the relative importance of factors such as thermal conduction, Coulomb heating of electrons, and external pressure; and to allow the explosions to occur in preexisting cavities with steep density gradients, or by examination of the effects of large obstructions or other anisotrophies in the ambient medium.

24532 **(RRK—83-9) Non-critical solution of a magnetic accretion disk.** Horiuchi, Ritoku. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jul 1983. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700839.

An accretion disk consisting of a perfectly conductive plasma is investigated on the assumption that the disk is geometrically thin, axially symmetric and steady. It is found that the solution can exist only in a super-Alfvenic region and does not necessarily approach to the Alfven critical point. The accretion flow is stopped at an inner boundary owing to the centrifugal force, and the amplification of toroidal magnetic fields gives rise to the swelling of the disk. Therefore, it is necessary to take account of either the magnetic interaction with a central star or the resistive process decreasing the magnetic fields near the inner boundary in order to obtain the steady disk.

24533 **(RRK—83-14) Some higher dimensional vacuum solutions of Einstein equations with a cosmological constant.** Ishihara, Hideki; Tomita, Kenji; Nariai, Hidekazu. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Oct 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700840.

As the first step to obtain a higher dimensional model of the universe, some solutions of vacuum Einstein equations with a non-vanishing cosmological term, whose topology is M_5(2-dim. space-time) x Nsub(n) (n-dim. external space with a constant curvature k = +1, 0, -1), are studied. In the case n = 3, some simple solutions are obtained.

24534 **(TRITA-EPP—84-02) Cosmogony as an extrapolation of magnetospheric research.** Alfven, H. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electron and Plasma Physics). Mar 1984. 54p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700838.

A theory of the origin and evolution of the Solar System (Alfven and Arrhenius, 1975: 1976) which considered electromagnetic forces and plasma effects is revised in the light of new information supplied by space research. In situ measurements in the magnetospheres and solar wind have changed our views of basic properties of cosmic plasmas. These results can be extrapolated both outwards in space, to interstellar clouds, and backwards in time, to the formation of the solar system. The first extrapolation leads to a revision of some cloud properties which are essential for the early phases in the formation of stars and solar nebule. The latter extrapolation makes it possible to approach the cosmogonic processes by extrapolation of rather well-known magnetospheric

phenomena. Pioneer-Voyager observations of the Saturnian rings indicate that essential parts of their structure are fossils from cosmogonic times. By using detailed information from these space missions, it seems possible to reconstruct certain events 4-5 billion years ago with an accuracy of a few percent. This will cause a change in our views of the evolution of the solar system.

24535 **Quantum mechanics of inflation.** Evans, M.; McCarthy, J.G. (Department of Physics, The Rockefeller University, New York, New York 10021). *Physical Review [Section] D: Particles and Fields;* **31**: No. 8, 1799-1806(15 Apr 1985). Contract AC02-81ER40033.

It is pointed out that the slow-roll equation of new-inflationary-universe models is not true in general for interacting field theories. We determine a set of conditions under which it is relevant, but argue that they are not likely to be satisfied by the early universe.

24536 **Source of the ^{26}Al observed in the interstellar medium.** Dearborn, D.S.P.; Blake, J.B. (Lawrence Livermore National Laboratory). *Astrophysical Journal, Letters to the Editor;* **288**: No. 1, L21-L24(1 Jan 1985).

Recent HEAO 3 observations have been interpreted by Mahoney and colleagues as requiring approximately 3 M/sub sun/ of ^{26}Al alive in the interstellar medium. Calculations briefly discussed in this Letter indicate that there is substantial production and dispersal of ^{26}Al in the stellar winds of O and W-R stars and suggest that the stellar winds of very massive stars are a significant source of ^{26}Al.

24537 **^{13}N(rho,γ)^{14}O thermonuclear reaction rate and the hot CNO cycle.** Mathews, G.J.; Dietrich, F.S. (University of California, Lawrence Livermore National Laboratory). *Astrophysical Journal;* **287**: No. 2, 969-980(15 Dec 1984). Contract W-7405-ENG-48.

New estimates for the ^{13}N(rho,γ)^{14}O reaction rate are presented. A direct-semidirect radiative capture model with a hydrodynamic core-polarization correction for quenching of the E1 transitions is utilized, together with spectroscopic information from measurements and shell-model calculations, to study the systematics of nucleon capture reactions on A = 12 and 13 nuclei. In particular, the resonance properties of the J/sup π/ = 1$^-$, 5.173 MeV first excited state in ^{14}O are derived along with an estimate for the nonresonant cross section. The new reaction rate is compared with other estimates and the implications of this rate on the conditions for the hot CNO cycle are discussed.

24538 **Limits from the soft x-ray background on the temperature of old neutron stars and on the flux of superheavy magnetic monopoles.** Kolb, E.W.; Turner, M.S. (Theoretical Astrophysics Group, Fermi National Accelerator Laboratory). *Astrophysical Journal;* **286**: No. 2, 702-710(15 Nov 1984). Contract AC02-80ER10773.

Using recent observations of the diffuse, soft X-ray background, we obtain upper limits of 49 eV to the average surface temperature and 10^{33} ergs s^{-1} to the total photon luminosity of old ($\sim 10^{10}$ yr) neutron stars in the Galaxy. If neutron stars are kept hot through monopole-induced nucleon decay, this limit corresponds to a monopole flux limit of F/sub M/($\sigma_0\beta$)< or =3r x 10^{-25} cm^{-2} sr^{-1} s^{-1}, where the cross section for catalyzed nucleon decay times the monopole-nucleon relative velocity is σv = 10^{-26}($\sigma_0\beta$c) cm^3 (β = v/c), and r = L/sub TOT//L/sub γ/ is the ratio of the total luminosity to the photon luminosity of a neutron star whose surface temperature Troughly-equal50 eV. For conventional neutron star equations of state rroughly-equal1, while for the more exotic ones r can be O(10^3-10^4). Although our temperature limit places a very stringent limit on the monopole flux, it does not significantly constrain other mechanisms for heating old neutron stars.

24539 **Neutron-capture nucleosynthesis of neodymium isotopes and the s-process from A = 130 to 150.** Mathews, G.J.; Kaeppeler, F. (University of California, Lawrence Livermore National Laboratory). *Astrophysical Journal;* **286**: No. 2, 810-821(15 Nov 1984). Contract W-7405-ENG-48.

New measurements of neutron capture cross sections for / sup 142,143,144/Nd are reported. These are combined with other recent measurements and applied to a detailed study of the s-process and r-process systematics for A = 130-150 nuclei. The influence of these results on the interpretation of isotopic anomalies observed in acid-insoluble residues and inclusions from the Allende meteorite is also examined. The uncertainties in the s-process σN curve are significantly diminished in the present work, and a fit is obtained which is consistent with all of the s-process-only isotopes in this region. A somewhat larger value than previous determinations is obtained for the mean neutron exposure for heavy nuclei in the s-process, tau$_0$ = 0.29-0.35 mb^{-1}. The derived r-process abundances decrease systematically from the A = 130 peak but exhibit a pronounced odd-even effect. The new results tend to confirm the hypothesis that the isotopic anomalies in materials from the Allende meteorite are the result of an unusual mixture of average solar-system s-process and r-process material, but an odd-even effect may be present in the r-process anomalies of inclusion EK1-4-1.

24540 **Supermassive monopole stars.** Fry, J.N.; Fuller, G.M. (Astronomy and Astrophysics Center, University of Chicago). *Astrophysical Journal;* **286**: No. 2, 397-402(15 Nov 1984). Contract AC02-80ER10773.

In this paper we reexamine the evolution of a superheavy monopole-dominated universe; in particular, we examine the evolution of rotation-stabilized monopole-burning "stars," balancing effects of radiation and annihilation. In contrast to earlier results, we find that this can lead to complete burning of all poles present in such an object within finite time. If monopoles can be brought within acceptable limits by dynamical processes, an inflationary epoch of the early universe need not be associated with grand unification.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 24487

24541 (CONF-790622—, pp 132-134) **Investigation into triggering lightning with a pulsed laser.** Schubert, C.W. Jr.; Lippert, J.R. (Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Theoretical and experimental considerations for the triggering of lightning with a high-power pulsed laser are discussed. The mechanisms of laser-induced clean air breakdown, aerosol breakdown, and channel heating over a long path for the purpose of initiating and possibly guiding lightning are reviewed. It is shown that long path (of the order of one kilometer) ionization through laser-induced clean air breakdown is theoretically possible. Channel heating over a long path appears possible, but requires prohibitive energies. Indications are that long path ionization can be enhanced by taking advantage of the significantly reduced power requirements for aerosol breakdown. The Mt. Baldy, New Mexico, experimental test site for 1978 to 1979 experiments and triggering attem$_{1}$ts is briefly described.

24542 **(N—85-14720) Activities report in Earth and planetary environments physics.** (Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France)). Jul 1984. 67p. (In French). (CRPE-NT—134). NTIS, PC A04/MF A01.

Ion media electrodynamics, natural plasma waves, low and middle atmosphere, electromagnetic communication and propagation theory, and space terrestrial instrumentation and data treatment were studied. The results obtained by the processing of data from Geos, ISEE and Arcad satellites and from the Eiscat radar are discussed. The activities in the field of natural plasmas include the Sherpa coherent radar for the study of ionospheric irregularities. (ESA)

24543 (TRITA-EPP—84-06) MHD dynamo action in space plasmas. Faelthammar, C.G. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electron and Plasma Physics). May 1984. 29p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700895.

Electric currents are now recognized to play a major role in the physical process of the Earths magnetosphere as well as in distant astrophysical plasmas. In driving these currents MHD dynamos as well as generators of a thermoelectric nature are important. The primary source of power for the Earths magnetospheric process is the solar wind, which supplies a voltage of the order of 200 kV across the magnetosphere. The direction of the large-scale solar wind electric field varies of many different time scales. The power input to the magnetosphere is closely correlated with the direction of the large-scale solar wind electric field in such a fashion as to mimick the response of a half-wave rectifier with a down-to-dusk conduction direction. Behind this apparently simple response there are complex plasma physical processes that are still very incompletely understood. They are intimately related to auroras, magnetic storms, radiation belts and changes in magnetospheric plasma populations. Similar dynamo actions should occur at other planets having magnetospheres. Recent observations seem to indicate that part of the power input to the Earths magnetosphere comes through MHD dynamo action of a forced plasma flow inside the flanks of the magnetopause and may play a role in other parts of the magnetosphere, too. An example of a cosmical MHD connected to a solid load is the corotating plasma of Jupiter's inner magnetosphere, sweeping past the planets inner satellites. In particular the electric currents thereby driven to and from the satellite Io have attracted considerable interest.

24544 Collisionless tearing in a field-reversed sheet pinch assuming nonparallel propagation. Quest, K.B.; Coroniti, F.V. (Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **90**: No. A2, 1458-1468(1 Feb 1985).

We examine the linear stability properties of the collisionless tearing in a reversed-field sheet pinch assuming that k x Bnot = 0, where B is the equilibrium magnetic field. We show that currents are driven in the direction perpendicular to the sheet pinch, a consequence of the differing drift response of the protons and electrons. This current is closed by a component parallel to B, resulting in strong field-aligned currents concentrated near the null line. Momentum balance is used to infer the functional shape of the current system at the null line, and it is demonstrated that the external current system cannot be carried by those particles with orbits crossing the null line. The relevance of this analysis to reconnection at the dayside magnetopause is discussed.

24545 Resonance-fluorescence in barium ion clouds. Horak, H.G.; Whitaker, R.W. (Los Alamos National Lab., NM). *Planetary and Space Science;* **30**: No. 9, 897-907(1982).

The problem of resonant-fluorescent scattering of sunlight by a high altitude, plane-parallel, barium ion cloud is solved numerically. Line strengths and profiles are computed using the modified version of the computer program LINEAR (Auer, Heasley and Milkey, 1972). Hyperfine structure of the spectral lines becomes important for very thick layers and is taken into account. Comparisons are made between coherent and completely noncoherent scattering results and finally the influence of collisions on the radiation field is estimated.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 24037, 24147, 24170, 24180, 24193, 24222, 24603, 24704, 24748, 24749, 24888

24546 (CBPF-NF—035/82) Molecular Orbital study of iron pentacarbonyl and its photochemical fragments Fe(CO) sub(n). Guenzburger, D.J.R.; Saitovitch, E.M.B.; De Paoli, M.A.; Manella, H. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1982. 34p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700485.

Self-consistent Molecular Orbital calculations were performed for $Fe(CO)_5$ and its photofragments Fe(CO) sub(n), $1 < = n < 5$. The discrete variational method was employed, with the $X\alpha$ local approximation for the exchange interaction. In the case of $Fe(CO)_5$, photoelectron and optical spectra are analysed, and photochemical behaviour is discussed. The Moessbauer isomer shifts and quadrupole splittings are investigated. In the case of $Fe(CO)_5$ and $Fe(CO)_4$, the values derived for these hyperfine interactions are compared to experimental measurements reported in a polyethylene matrix.

24547 (DOE/EV/04703—45) Interaction of slow electrons with high-pressure gases ('Quasi-liquids'): synthesis of our knowledge on slow electron-molecule interactions. Progress report. McCorkle, D.L.; Christophorou, L.G. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). 1985. Contract AS05-76EV04703. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010061.

A crucial step in our efforts to develop not only a coherent picture of radiation interaction with matter, but also to understand radiation effects and mechanisms, as well as the effects of chemical pollutants and toxic compounds, is to relate the often abundant knowledge on isolated molecules (low pressure gases) to that on liquids or solids. To understand the roles of the physical and chemical properties of molecules in biological reactions, we must know how these isolated-molecule properties change as molecules are embedded in gradually thicker and thicker (denser and denser) gaseous and, finally, liquid environments. The work initiated by us both at the Physics Department of The University of Tennessee and at the Oak Ridge National Laboratory addresses itself to this question. At both places, high pressure (40 to ~8000 kPa) electron swarm experiments are currently in operation yielding information as to the effects of the density and nature of the environment on fundamental electron-molecule interaction processes at densities intermediate to those corresponding to low pressure gases and liquids, and the gradual transition from isolated molecule to condensed phase behavior.

24548 (FEI—1443) Atom collisions in plasma of the nuclear origin. Part 1. Parashchuk, A.V.; Yudin, G.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700820.

The introductory part of the general problem of investigation of elementary collision processes in a plasma of the nuclear origin is reported. The Grizinski approach to calculation of excitation cross section and ionization of atomic systems by contaminated particles is discussed in detail. In the framework of the Bethe-Born theory for neutral atoms estimations of total ionization cross sections knocking out electrons from various subshells. With growth of the target atomic number a tendency to emergence of inverse population for sublevel pairs 2S-2Psub(1/2), 3S-3Psub(1/2), 3Psub(3/2)-3Dsub(3/2), 3Psub(3/2)-3Dsub(5/2), 4S-4Psub(1/2) and 4Psub(3/2)-4Dsub(3/2) appears.

24549 (INIS-mf—9279) Detection of antisymmetric tensor contribution to the magnetic screening of ^{13}C nuclei. Kuhn, W. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1983. 142p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780823.

In the present thesis for the first time a practical way for the detection of antisymmetric contributions to the tensor of the magnetic screening of atomic nuclei is indicated. The detection is based on the relaxation efficiency of the antisymmetric screening. The measurements were performed on the ^{13}C nuclei of phthalic acid anhydride. Measured were the spin-lattice relaxation times of all ^{13}C nuclei of the molecule at field strengths between 4.69 T and 11.74 T, this corresponds to ^{1}H resonance frequencies in the range from 200 MHz to 500 MHz. From this the interaction-specific relaxation rates could be determined without problems. The space-group of the crystal and the molecule geometry were determined by X-ray structure analysis. For the accurate determination of the hydrogen position on a deuterated monocrystal by means of deuterium nuclear resonance measurements the electric field gradient tensors were measured and from the orientation of the main axes of

these tensors the bonding angles calculated. On a monocrystal enriched in the C(7) respectively C(8) position with ^{13}C the symmetric part of the tensor of the magnetic screening of these two nuclei was measured. With these values and the relaxation rates of the ^{13}C nuclei by an iterative procedure from the equations for the theoretical relaxation rates of all ^{13}C nuclei of the molecule the main values of the rotation-diffusion tensor could be determined. On the base of the plane molecule geometry from this the tensor element sigmasub(xz)sup(A) could be explicety detected according to an amount of 11.7 ppm.

24550 (INIS-mf—9506) Small angle elastic scattering of electrons by noble gas atoms. Wagenaar, R.W. (Amsterdam Univ. (Netherlands)). 15 Feb 1984. 190p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780826.

Includes Dutch summary.

In this thesis, measurements are carried out to obtain small angle elastic differential cross sections in order to check the validity of Kramers-Kronig dispersion relations for electrons scattered by noble gas atoms. First, total cross sections are obtained for argon, krypton and xenon. Next, a parallel plate electrostatic energy analyser for the simultaneous measurement of doubly differential cross section for small angle electron scattering is described. Also absolute differential cross sections are reported. Finally the forward dispersion relation for electron-helium collisions is dealt with.

24551 (INIS-mf—9507) Chemical sputtering. Induced by keV ion bombardment. Haring, R.A. (Rijksuniversiteit Leiden (Netherlands)). 11 Apr 1984. 179p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780828.

Includes Dutch summary.

In this thesis, the author focuses on chemical sputtering by keV ions, treating two specific examples: the chemical effects occurring when bombarding simple condensed gases and the mechanisms of the ion-assisted etching process. First, however, the mechanism of sputtering of condensed gases in general is discussed. These mechanisms have been investigated using condensed noble gases as target material. The thesis is a compilation of articles published elsewhere. Contents: sputtering of condensed noble gases by keV heavy ions; surface distribution as an observable factor in the energy distribution of sputtered particles; reactive sputtering of simple condensed gases by keV heavy ion bombardment; mass spectra of nozzle-produced small molecular clusters of H_2O, NH_3, CO and CH_4; mass and energy distribution of particles sputter-etched from Si in a XeF_2 environment; argon-ion assisted etching of silicon by molecular chlorine; energy distribution of sputtered polyatomic molecules.

24552 (ITEF—57(1983)) Positronium formation in noble gases. Byakov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700819.

It is shown that the probability of positronium formation due to pressure characteristic of gaseous xenon - linear increase with growth of gas density changed then by its sharp reduction - receives a natural explanation in the supposition that positronium formation proceeds by positron (e^+) recombination with one of the delta electrons. Localization (solvation) of electrons in clusters arising as a result of density fluctuations, that is manifested experimentally in decrease of mobility, stipulates decrease of the positronium formation probability at high pressures. The efficiency of positronium formation by the charge exchange mechanism $e^+ + A \rightarrow P_s + A^+$, in difference with other inertial gases, in Xe is low due to high energy losses by a positron for inelastic collisions with Van der Waals dimers Xe_2.

24553 (JAERI-M—83-143) Data on collisions of hydrogen atoms and ions with atoms and molecules, (2). Cross sections for charge transfer of H, H^+ and H^- with He, Ne, Ar, Kr and Xe. Nakai, Yohta; Kikuchi, Akira; Shirai, Toshizo; Sataka, Masao. (Japan Atomic Energy Research Inst., Tokyo). Sep 1983. 117p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85700821.

This report presents a compilation of the experimental data on cross sections for charge transfer of H, H^+ and H^- with inert gases such as He, Ne, Ar, Kr and Xe. A survey has been made systematically of the literatures up to the end of 1982. The cross sections are given as a function of projectile energy in graphs and tables; a list of references is also attached.

24554 (JAERI-M—83-155) Atomic structure calculation of energy levels and oscillator strengths in Ti ion, 1. 3s-3p and 3p-3d transitions in Ti IX. Ishii, Keishi. (Japan Atomic Energy Research Inst., Tokyo). Sep 1983. 53p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700815.

Energy levels and oscillator strengths are calculated for 3s-3p and 3p-3d transition arrays in Ti IX, isoelectronic to Si I. The energy levels are obtained by the Slater-Condon theory of atomic structure including explicitly the strong configuration interactions, and are given both in numerical tables and in diagrams. The calculated wavelengths, oscillator strengths and transition probabilities are presented in tables and are also displayed in figures, where the weighted oscillator strengths are plotted as a function of wavelength.

24555 (JAERI-M—83-164) Atomic structure calculation of energy levels and oscillator strengths in Ti ion, 2. 3s-3p and 3p-3d transitions in Ti X. Ishii, Keishi. (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700816.

Energy levels and oscillator strengths are calculated for 3s-3p and 3p-3d transition arrays in Ti X, isoelectronic to Al I. The energy levels are obtained by the Slater-Condon theory of atomic structure, including explicitly the strong configuration interactions. The results are presented both in numerical tables and in diagrams. In the tables, the observed data are included for comparison, where available. The calculated weighted oscillator strengths (gf-value) are also displayed in figures, where the weighted oscillator strengths are plotted as a function of wavelength.

24556 (JAERI-M—83-198) Atomic structure calculation of energy levels and oscillator strengths in Ti ion, 3. 3s - 3p and 3p - 3d transitions in Ti XI. Ishii, Keishi. (Japan Atomic Energy Research Inst., Tokyo). Nov 1983. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700817.

Energy levels and oscillator strengths were calculated for 3s-3p and 3p-3d transition arrays in Ti XI, isoelectronic to Mg I. The energy levels are obtained by the Slater-Condon theory of atomic structure, including explicitly the strong configuration interactions. The calculated wavelengths are presented for electric dipole transition with gf >= 0.0001. The calculated energy levels are given in diagrams, too. The theoretical spectra are also shown in graphical representation, where the gf is plotted as a function of the wavelength. The results are compared with experimental data, where available.

24557 (JINR—R-7-83-57) Characteristic X-radiation and electron binding energies of highly charged noble gas ions. Shchornak, G.; Muziol', G.; Pil'ts, R. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1983. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700818.

Submitted to the journal Opt. Spectrosk. .

The energies of characteristic X-ray and electron binding energies of highly charged noble gas ions are computed for a successive increasing number of outer-shell vacancies by the Dirac-Fock-Slater method. X-ray energy shifts for the K- and L-series of neon, argon, krypton and xenon have been obtained. For these elements binding energy shifts for the K -, L_3- and M_3-orbitals are also discussed. For configurations [noble gas] and [noble gas]sub(nd)sup(10) (n=3, 4) strong alterations of the investigated atomic parameters are met. Calculatis for the change of the X-ray rates in the argon K-series by increasing outer-shell ionization are provided. Comparisons between experimental and theoretical results show that the accuracy of the calculated values due to experiments are in the range of about 5%.

24558 (JINR-R—7-83-627) Measurement of characteristics X-ray produced by spectra slow hydrogen-like argon ions incident on solid targets. Donets, E.D.; Shchornak, G.; Trifonov, V.A.; Tutin, G.A.; Ehjsmont, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700830.

Submitted to the journal Sov. Phys. - JETP.

The measurements of K-(shell) X-rays arising when Ar^{17+} ions are incident on Be(BeO) and Cu(CuO) targets under energies of about 500 eV/nucl and 50 eV/nucl are performed. The cryogenic electron beam ionizer was used for production of Ar^{17+} beam and x-rays were detected by means of a superpure Ge spectrometer. It has been found that transitions to the 1s-states occur under considerable population of L-stell (4 vacancies on the average). K-(shell) x-ray spectra do not depend in the error limits neither on ion velocity nor on material of the targets used. Possible processes of shell populations of highly charged ions are discussed.

24559 (KFTI—83-33) Simulation of physical sputtering of metal surface: certification of modified method of binary collisions. Vajsfel'd, A.M.; Slabospitskij, R.P.; Yamnitskij, V.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700831.

A modified method of binary collisions and its application for simulation of metal surface sputtering is considered. The conventional methods possess an insufficient speed of response and incomplete adequacy to the experiment. The proposed model possesses a considerably higher speed of response and fuller account of factors affecting the sputtering process. Particular attention is given to the problem of experimental certification of the program. Using as an example physical sputtering of nickel and copper by nickel- and argon ions, respectively, a perfect agreement between model results and the experiment is shown: the sputtering coefficient dependence on the ion energy and incidence angle, angular- and energy distributions of sputtered atoms. Studies on prospects for using the new method are considered.

24560 (ORNL—6157) 1984 Bibliography of atomic and molecular processes. Barnett, C.F.; Gilbody, H.B.; Gregory, D.C.; Griffin, P.M.; Havener, C.C.; Howard, A.M.; Kirkpatrick, M.I.; McDaniel, E.W.; Meyer, F.W.; Morgan, T.J. (comps.). (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 209p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85010583.

This annotated bibliography includes papers on atomic and molecular processes published during 1984. Sources include scientific journals, conference proceedings, and books. Each entry is designated by one or more of the 114 categories of atomic and molecular processes used by the Controlled Fusion Atomic Data Center, Oak Ridge National Laboratory to classify data. Also indicated is whether the work was experimental or theoretical, what energy range was covered, what reactants were investigated, and the country of origin of the first author. Following the bibliographical listing, the entries are indexed according to the categories and according to reactants within each subcategory.

24561 (PUC-TN—06/82) Interaction of strong electromagnetic fields with atoms. Brandi, H.S.; Davidovich, L.; Zagury, N. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Jun 1982. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700491.

Several non-linear processes involvoing the interaction of atoms with strong laser fields are discussed, with particular emphasis on the ionization problem. Non-perturbative methods which have been proposed to tackle this problem are analysed, and shown to correspond to an expansion in the intra-atomic potential. The relation between tunneling and multiphoton absorption as ionization mechanisms, and the generalization of Einstein's photoelectric equation to the strong-field case are discussed.

24562 (PUC-TN—13/82) Non-perturbative methods applied to multiphoton ionization. Brandi, H.S.; Davidovich, L.; Zagury, N. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Sep 1982. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700486.

The use of non-perturbative methods in the treatment of atomic ionization is discussed. Particular attention is given to schemes of the type proposed by Keldysh where multiphoton ionization and tunnel auto-ionization occur for high intensity fields. These methods are shown to correspond to a certain type of expansion of the T-matrix in the intra-atomic potential; in this manner a criterium concerning the range of application of these non-perturbative schemes is suggested. A brief comparison between the ionization rate of atoms in the presence of linearly and circularly polarized light is presented.

24563 (PUC-TN—16/82) M-subshell ionization of Au, Pb, Bi and U by protons. Castro Faria, N.V. de; Freire Junior, F.L.; Pinho, A.G. de; Silveira, E.F. da. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Oct 1982. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700492.

M-subshell ionization cross section of Au, Pb, Bi and U by protons bombardment were obtained over the projectile range 0.3 - 4.0 MeV. X-ray were detected by Si(Li) spectroscopy. At least one characteristic radiative transition line for each M-subshell was isolated and measured. Radiative and non-radiative branching ratios were taken from theoretical calculations of Bhalla and McGuire. Our total production X-ray cross sections are compared with the measurements of other authors. Comparison of our scaled subshell ionization cross sections with calculations in the plane-wave Born approximation shows, in general, good agreement. Uncertainties in fluorescence yields and in super Coster-Kronig coefficients can introduce great imprecision in some experimentally determined subshell ionizations cross sections.

24564 (PUC-TN—19/82) Electrons and atoms in intense laser fields. Davidovich, L. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Nov 1982. 28p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700487.

Several non-linear effects that show up when electrons and atoms interact with strong laser fields are considered. Thomson scattering, electron potential scattering in the presence of a laser beam, atomic ionization by strong laser fields, the refraction of electrons by laser beams and the Kapitza-Dirac effect are discussed.

24565 Simplified Monte Carlo electron transport algorithm for advanced bremsstrahlung converter design calculations. Pregenzer, A.; Morel, J.E. (Simulation Theory Division, 1231, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **57**: No. 11, 4849-4855(1 Jun 1985).

A fast and simple algorithm is presented for calculating the effects of energy loss and scattering on electrons which pass through a converter foil. This algorithm is designed to be integrated into particle-in-cell codes for electron-beam transport. The results of this algorithm for such quantities as energy and number transmission and reflection coefficients compare very favorably with results obtained from a more sophisticated Monte Carlo transport code for pertinent applications. The savings in time is appreciable: this algorithm is approximately 30 times faster than the more sophisticated code.

24566 High brightness electrostatically focused field emission electron gun for free electron laser applications. Kirkpatrick, D.A.; Shefer, R.E.; Bekefi, G. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge Massachusetts 02139). *Journal of Applied Physics;* **57**: No. 11, 5011-5016(1 Jun 1985).

An electrostatically focused, multistage electron gun using a cold (field emission) cathode has been developed for use in a free electron laser. This gun produces a 1.1-kA, 2.0-MV electron beam with a normalized emittance ϵ/sub n/$\approx$38 x 10^{-3} (π cm rad), and a

brightness of 74 kA/cm² rad². The measured brightness is almost two orders of magnitude higher than that found in most RF linacs using conventional thermionic cathodes, and is comparable to that achieved using electron guns immersed in strong guiding magnetic fields. The emittance and brightness have been studied as a function of cathode material, surface finish, and the electric field strength at the cathode surface.

24567 **Geometric and electronic structure of small copper clusters Cu/sub n/ and Cu$^+$/sub n/ (n = 1—3) by an effective core potential method.** Wang, S. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **82**: No. 10, 4633-4640(15 May 1985).

Electronic structure calculations have been carried out for the total energy of the ground state of Cu/sub n/ and Cu$^+$/sub n/ (n = 1—3) clusters. The Cu atom is treated as a one-electron system and the effect of the core is approximated by a shape consistent pseudopotential and a semiempirical core-valence, core—core polarization potential. The exchange and correlation energies among the valence electrons are treated by the local-spin-density-functional approximation with and without the self-interaction corrections (SIC). The binding energy and bond distance of Cu_3 calculated with SIC are in almost exact agreement with experimental data. The calculated ionization potentials exhibit even—odd oscillations as a function of n. The potential energy surfaces of Cu_3 show substantial differences when obtained with and without SIC. The most stable geometry predicted by the latter is an acute triangle with an apex angle of 47° and a long bond length of 5.41 a.u. In terms of a distortion parameter rho with respect to an equilateral triangle with an equilibrium bond length of 4.78 a.u. we have rho = 0.435 a.u. This is in excellent agreement with the experimental value of rho = 0.472 a.u. The calculated binding energy of Cu_3 with respect to fragmentation into Cu atoms is 2.259 eV in comparison with the experimental value of 3.108 +- 0.135 or 3.058 +- 0.151 eV. The 27% error is probably due to the use of local exchange-correlation energies and the somewhat small basis set.

24568 **Study of the quantal time delay matrix in collinear reactive scattering.** Abu-Salbi, N.; Kouri, D.J.; Baer, M.; Pollak, E. (Department of Chemistry, University of Houston, Houston, Texas 77004). *Journal of Chemical Physics;* **82**: No. 10, 4500-4508(15 May 1985).

The Eisenbud—Wigner time delay matrix is used to study the dynamics of reaction close to vibrationally adiabatic barrier energies. Maxima in the time delay are predicted and are found to be in excellent agreement with vibrationally adiabatic barrier energies determined by quantized pods. The actual time spent in the vicinity of the barriers is estimated by separating out the free particle time. This "real time" is then used to analyze the validity of the adiabatic and sudden approaches to reactive scattering in the 3D H+H_2 and D+H_2 reactions.

24569 **Analytic representation of the dipole oscillator-strength distribution. II. The normalization factor for electron continuum states in atomic fields.** Dillon, M.A.; Inokuti, M. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **82**: No. 10, 4415-4425(15 May 1985).

We address ourselves to the question what analytic formula is the most suitable for fitting the dipole oscillator-strength distribution df/dϵ over a wide range of the kinetic energy ϵ of an electron ejected from an atom or molecule. A suitable expression will enable one to interpolate or extrapolate data reliably and to use them readily in applications such as the modeling studies in radiation physics. It is useful to distinguish two factors that together constitute df/dϵ. The first factor is defined in terms of the dipole matrix element with respect to a final-state eigenfunction whose amplitude near the origin is independent of ϵ. As we showed earlier, this factor is analytic at all finite ϵ except at a singularity at ϵ = -I, where I is the ionization threshold energy. The other factor arises from the energy-scale normalization of the final-state eigenfunction, and is the object of the present discussion from several angles. First, we present a survey of numerical data for the s,p, and d states with 0< or =ϵ< or =5 a.u. for all atoms with Z< or =38, evaluated within the Hartree—Slater potential model.

24570 **Effects of translational energy and moderators on vibrational excitation of carbon dioxide by hot hydrogen atoms.** McGee, T.H.; Weston, R.E. Jr.; Flynn, G.W. (Chemistry Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Chemical Physics;* **82**: No. 8, 3607-3612(15 Apr 1985). Contract AC02-76CH00016;AC02-78ER04940.

The collisional thermalization of hot H atoms produced by the excimer laser photolysis of H_2S (193 nm) and HI (193 and 248 nm) has been determined by measuring the decrease in vibrational excitation of CO_2 (ν_3) as a function of moderator pressure. Cross sections obtained for the rare gases in this way are in reasonable agreement with those calculated for energy loss in hard-sphere collisions. These experiments also indicate that the efficiency of vibrational excitation increases as the relative translational energy increases.

24571 **Muon—alpha-particle sticking probability in muon-catalyzed fusion.** Ceperley, D.; Alder, B.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] A: General Physics;* **31**: No. 4, 1999-2004(Apr 1985).

The Green's-function Monte Carlo method is used to calculate the ground-state wave function of the muonic-molecular ion composed of a negative muon bound to a deuteron and a triton. Using the sudden approximation, the probability that the muon will remain bound to the escaping alpha particle after fusion occurs is found to be 0.90%, about 25% smaller than previous estimates based on the Born-Oppenheimer approximation. The numerical method for determining the wave function is discussed in detail.

24572 **Electron-detachment spectroscopy of 20—100-keV H$^-$ projectiles interacting with thin Ar targets.** Alton, G.D.; Compton, R.N.; Pegg, D.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] A: General Physics;* **31**: No. 4, 2129-2136(Apr 1985).

Energy and transformed-velocity spectra of electrons emitted in the forward direction have been experimentally determined for 20—120-keV H$^-$ projectiles traversing thin Ar targets. The spectra from H$^-$ are surprisingly cusplike in shape even though single-electron loss is known to dominate. In contrast to the findings of Menendez and Duncan, who performed similar measurements at higher projectile velocities, target-induced structures in the electron loss to the continuum spectra are not pronounced in this velocity regime.

24573 **Energy dependence of inelastic electron scattering cross section by surface vibrations: Experimental measurement and theoretical interpretation.** Xu, M.; Hall, B.M.; Tong, S.Y.; Rocca, M.; Ibach, H.; Lehwald, S.; Black, J.E. (Department of Physics and the Laboratory for Surface Studies, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201). *Physical Review Letters;* **54**: No. 11, 1171-1174(18 Mar 1985). Contract FG02-84ER45076.

We report on the first comparison of the inelastic cross section of Ni(001) surface phonons for an extended energy range with a dynamical scattering theory. Both theory and experiment indicate large modulations in the loss cross section as a function of incident energy. The intensity ratio of the S_4 and S_6 surface phonons on Ni(001) is best fitted with a 1.7%—3.3% contraction in the outermost interlayer spacing.

24574 **Threshold excitation of short-lived atomic inner-shell hole states with synchrotron radiation.** Armen, G.B.; Aberg, T.; Levin, J.C.; Crasemann, B.; Chen, M.H.; Ice, G.E.; Brown, G.S. (Department of Physics and Chemical Physics Institute, University of Oregon, Eugene, Oregon 97403). *Physical Review Letters;* **54**: No. 11, 1142-1145(18 Mar 1985).

The Xe L_3-M_4M_5($^1G_4$) Auger spectrum, photoexcited in the vicinity of the L_3 edge, has been measured as a function of photon energy. The nd spectator-electron satellite lines show resonant behavior. The diagram line exhibits the largest (> or ≈1 eV) post-collision interaction shift yet observed. For comparison with the data, the first fully quantum-mechanical calculation of the post-col-

lision interaction in deep inner-shell Auger decay is performed, based on a resonant scattering approach that involves a complete summation over intermediate L_0 one-hole states.

24575 Effects of autoionization on the alignment of Cd^+ ($4d^9 5s^2\ ^2D_{5/2}$) in the range 680—710 A. Goodman, Z.M.; Caldwell, C.D.; White, M.G. (Department of Physics, Yale University, New Haven, Connecticut 06511). *Physical Review Letters;* **54**: No. 11, 1156-1159(18 Mar 1985).

The alignment of the $4d^9 5s^2\ ^2D_{5/2}$ state of Cd^+ is obtained from fluorescence polarization measurements using dispersed synchrotron radiation in the spectral region 680 to 710 A. This region is dominated by strong autoionization features associated with the $nf(^1P_1)$ and $np(^3P_1, ^3D_1)$ Rydberg states converging to the $4d^9 5s^2\ ^3D_{3/2}$ fine-structure threshold. The polarization and alignment data show marked variations across the resonance profiles and are compared with recent calculations in the relativistic random-phase approximations in conjunction with multichannel quantum-defect theory.

24576 Calculation of a P- andT-nonconserving weak interaction in Xe and Hg with many-body perturbation theory. Mrtensson-Pendrill, A. (Department of Physics, Chalmers University of Technology, S-412 96 Goeteborg, Sweden). *Physical Review Letters;* **54**: No. 11, 1153-1155(18 Mar 1985).

The electronic part of a possible P- and T-nonconserving neutral-weak-current—induced electric dipole moment in atomic Xe and Hg was calculated with many-body perturbation theory. After the effects of this P- and T-nonconserving interaction on all core orbitals were treated self-consistently, thereby including all single-particle effects to all orders but no correlation effects, the results mu-arrow-right/sub e/ = (5.2 x 10^{-23}e m)C/sub T/sigma-arrow-right/sub N/ and mu-arrow-right/sub e/ = -(6.0 x 10^{-22}e m)C/sub T/sigma-arrow-right/sub N/, respectively, were obtained for Xe and Hg. The value for Xe can be combined with the recent experimental result, 'mu-arrow-right/sub e/(^{129}Xe)'$<10^{-28}$ e m, obtained at University of Washington, to give the upper limit 'C/sub T/'$<2 \times 10^{-6}$.

24577 Isoelectronic studies of the $4s4p\ ^3P_J$ energy levels in the Zn sequence. Curtis, L.J. (Department of Physics and Astronomy, University of Toledo, Toledo, Ohio 43606). *Journal of the Optical Society of America B: Optical Physics;* **2**: No. 3, 407-410(Mar 1985). Contract AS05-80ER10676.

Screening parameterizations of the spin—orbit and exchange energies are used to systematize available data accurately for the 4s4p configuration in the Zn isoelectronic sequence. Through the availability of precision measurements of the $4s^2\ ^1S_0$—$4s4p\ ^1P_1$ resonance transition, these screening parameterizations are used to make accurate interpolative and extrapolative predictions of the excitation energies of the $4s4p\ ^3P_J$ levels for ions from Ge III through Ba XXVII. These results also provide extrapolative predictions of the magnetic-dipole, electric-quadrupole, and intercombination transitions in this system that sometimes occur in localized diagnostics of high-temperature plasmas.

24578 Optical pumping with a frequency-modulated multimode dye laser. Giberson, K.W.; Hammond, M.S.; Hart, M.W.; Lynn, J.G.; Dunning, F.B. (Departments of Space Physics and Astronomy and Physics and the Rice Quantum Institute, Rice University, Houston, Texas 77251). *Optics Letters;* **10**: No. 3, 119-121(Mar 1985).

Efficient, stable optical pumping of a collimated beam of $Ar(^3P_2)$ metastable atoms is obtained using a low-power, frequency-modulated multimode dye laser. The advantages provided by frequency modulation are discussed. The technique is suitable for use in optically pumping a wide variety of atomic species.

24579 Spectral line intensities for the O I, N I, C I, B I, and Be I isoelectronic sequences, Z = 26—36. Feldman, U.; Seely, J.F.; Bhatia, A.K. (E. O. Hulburt Center for Space Research, Naval Research Laboratory, Washington, D.C. 20375). *Atomic Data and Nuclear Data Tables;* **32**: No. 2, 305-341(Mar 1985).

The spectral line intensities for the O I, N I, C I, B I, and Be I isoelectronic sequences and for Z = 26, 28, 30, 32, 34, and 36 are presented. The transitions are of the types $2s^2 2p$/sup k/—2s2p/sup k/+1, 2s2p/sup k/+1—2p/sup k/+2, $2s^2 2p$/sup k/—$2s^2 2k$/sup k/, and 2s2p/sup k/+1—2s2p/sup k/+1. The simulated spectra are useful for the identification of allowed and forbidden transitions in the wavelength range 40 to 2300 A in tokamak plasmas. The line intensities are calculated for an electron density of 2.5 x 10^{13} cm^{-3} and for an electron temperature approximately equal to the temperature for maximum abundance of each ion in the case of coronal equilibrium.

24580 Completely quantal treatment of the van der Waals forces between atoms: Application to positronium. Manson, J.R.; Ritchie, R.H. (Department of Physics and Astronomy, Clemson University, Clemson, South Carolina 29631). *Physical Review Letters;* **54**: No. 8, 785-788(25 Feb 1985). Contract W-7405-ENG-26.

The attractive interaction between atoms is described as a self-energy in which the effects of recoil and finite relative velocity are treated exactly. For systems involving positronium significant deviations from the van der Waals potential are found due to both recoil and relative motion.

24581 Photoelectron angular distributions for near-threshold two-photon ionization of cesium and rubidium atoms. Dodhy, A.; Compton, R.N.; Stockdale, J.A.D. (Physics Department, Auburn University, Auburn, Alabama 36849 and Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **54**: No. 5, 422-425(4 Feb 1985). Contract AC05-84OR21400.

Photoelectron angular distributions have been measured for nonresonant two-photon ionization of cesium and rubidium atoms just above the ionization threshold. The photoelectron energies ranged from 25 to 100 meV. The results are compared with theoretical estimates based on nonrelativistic atomic wave functions. Initial results are also presented for above-threshold ionization in cesium.

24582 Two-color multiphoton ionization of xenon. Compton, R.N.; Miller, J.C. (Chemical Physics Section, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of the Optical Society of America B: Optical Physics;* **2**: No. 2, 355-361(Feb 1985). Contract AC05-84OR21400.

Two independently tunable, linearly polarized dye lasers have been used to study multiphoton ionization of gaseous xenon. One laser is tuned near three-photon resonance with the allowed 6s[3/2]/sup degree//sub J/ = 1 resonance, which is not observed with one laser at these pressures because of the destructive interference between the three-photon-excitation and third-harmonic-excitation pathways to the 6s[3/2]/sup degree//sub J/ = 1 state. The second laser is tuned to resonance with higher allowed np and np' sstates of xenon. The missing ionization signal is seen to be dramatically restored by the addition of the second laser beam; however, the signal again disappears as the pressure is increased. These results are discussed in relation to recent experimental and theoretical studies of cancellation effects between three-photon excitation and third-harmonic generation. Spectroscopic information obtained from tuning each dye laser, together with data on the angular distributions resulting from rotating the plane of polarization of one laser relative to that of the second laser, clearly shows that two different ionization mechanisms are operative. In addition, these experiments unambiguously illustrate the importancce of dissociative ionization of quasi-dimers of xenon over a rather broad frequency range.

24583 Numerical calculations of electron-impact ionization. Bottcher, C. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Advances in Atomic and Molecular Physics;* **20**: No. 1, 241-325(1985). Contract W-7405-ENG-26.

The time dependent wave packet method is used to described the ionization of H atoms by electrons. (AIP)

24584 High vibrational overtones in $SiHCl_3$ and $SiHCl_2$. Bernheim, R.A.; Lampe, F.W.; O'Keefe, J.F.; Qualey, J.R. III. (Pennsylvania State Univ., University Park). *Chemical Physics Letters;* **100**: No. 1, 45-50(26 Aug 1983).

Absorption spectra in the 12,000-18,000 cm^{-1} range have been recorded for gaseous $SiHCl_3$ and SiH_2Cl_2 using intracavity photoacoustic detection and cw dye lasers. The observed transitions correspond to the $\Delta v = 6, 7, 8$ and 9 overtones of the Si-H stretch and are adequately interpreted in terms of a local mode description of the vibration.

24585 Mechanisms for rapid electron transfer in ionic solids following multiple ionization by heavy-ion impact. Watson, R.L.; Benka, O.; Parthasaradhi, K.; Kenefick, R.A.; Maurer, R.J.; Sanders, J.M.; Bandong, B.; Ritter, T. (Texas A & M Univ., College Station). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **30**: No. 2, 919-922(Apr 1983).

Systematic measurements of the spectra of fluorine Kα x-rays produced by the bombardment of alkali and alkaline earth fluorides with 2-MeV/amu ions ranging from He to Ar have given new information on the mechanisms for rapid electron transfer within the K-hole lifetime ($\sim 10^{-13}$ sec.). Spectra obtained with He ions provide clear evidence of the occurrence of resonant electron transfer (RET) following 1s2p ionization of F^- in the compounds KF and SrF_2. Calculations employing a point-charge model support the conclusion that the anomalously low KL^1 x-ray satellite intensities observed for these two compounds are the result of a resonant exchange of an electron between the outermost p level of the metal ion and the 2p level of the fluorine ion. Such a transfer mechanism requires a close match between the energies of the two levels involved. Recent measurements using 22-MeV carbon ions have revealed that the KL^3 satellite intensity in CaF_2 is much lower than that displayed by any of the other group II fluorides, there-by suggesting RET also occurs in association with this double L-hole state. When high states of ionization are produced, rapid electron transfer to the fluorine L-shell becomes highly probable even in the absence of level matching. 10 references, 2 figures.

24586 Electrons on corrugated surfaces. Kalia, R.K.; Vashishta, P.; Mahanti, S.D.; Quinn, J.J. (Argonne National Lab., IL). *Journal of Physics C: Solid State Physics;* **16**: 491-495(1983).

The authors report the first molecular-dynamics (MD) study of electrons on a periodically corrugated surface. The aim is to study the effects of height and wavevector of the corrugation on structural and dynamical properties of electrons at finite temperature. These properties include density maps, pair-correlation functions, snapshots of particle positions, velocity auto-correlation functions, and diffusion along (D/sub x/) and normal (D/sub y/) to the corrugation. In this system the total internal energy, the corrugation and Coulomb contributions to the internal energy, and diffusion constants are found to vary periodically with the wavevector of the corrugation. 13 references, 3 figures.

24587 Injection and storage of singly charged ions and extension of the principles of ion storage to highly charged low-energy recoil ions. Schuessler, H.A.; Chun-Sing, O.; Lakkaraju, H.S. (Texas A and M Univ., College Station). *Physica Scripta;* **T3**: 27-32(1983).

The various aspects of injecting singly and multiply charged ions into harmonic and nonharmonic ion trap devices are discussed. Injection of a continuous ion beam into an active trap was evaluated by numerical integration of the Mathieu equations to determine the finite confinement time of the injected ions. Three different modes of operation of the ion trap, namely, the radio-frequency (RF), the Penning, and the combined RF and Penning modes were considered. On the other hand the phase-space method was used for a pulsed ion beam injected into the RF quadrupole ion trap for which the RF quadrupole field was switched on after the ion injection. In this way, a high trapping efficiency is reached for a suitable combination of the chosen initial RF voltage phase angle and the delay time after the ion injection. In addition, the trapped ions are confined indefinitely and energy- and mass-selective storage of the injected ions are also possible. The occurrence of ion motion induced side bands in the spectrum of stored ions and their importance for determining the ion temperature are discussed. Scaling relations are give that relate the results obtained for singly charged ions to the storage properties as they pertain to highly charged ions. Use is made of the unique environment of ion traps to speculate about novel collision and high-resolution spectroscopy experiments on highly charged ions.

24588 Recent progress in atomic and molecular collisions and the interface with electronic structure theory. Truhlar, D.G. (Univ. of Minnesota, Minneapolis). *International Journal of Quantum Chemistry;* **17**: 77-87(1983). Contract AC02-79ER10425.

Some examples of areas in atomic and molecular collisions where there has been recent progress - in theory, in computations, or in experimental work - are discussed, and the new needs from electronic structure theory are stressed. 76 references, 2 tables.

24589 Multiphoton laser ionization mass spectrometry of cesium iodide and atomic iodine. Balooch, M.; Olander, D.R. (Univ. of California, Berkeley). *International Journal of Mass Spectrometry and Ion Physics;* **51**: 155-164(1983). Contract AC03-76SF00098.

Using the technique of laser ionization mass spectrometry, a study of multiphoton ionization (MPI) of atomic iodine and cesium iodide was conducted with a tunable dye laser. One of the objectives was to determine if this technique provides more selective ionization of the components of such a mixture than does conventional electron bombardment. It was found that under intense photon irradiation, CsI fragments to I^+ by a multistep process. The first step is dissociation of CsI which is followed by multiphoton ionization of the liberated atomic iodine. Because of this mechanism, the atomic iodine in a CsI + I mixture with less than 10% iodine cannot be detected by MPI at the available photon wavelengths (2800-3000 A). However, operation at wavelengths which preclude dissociation of CsI should greatly improve the selectivity. The cross-section for two-photon excitation of iodide at 3047 A was determined to be 4×10^{-50} cm^4 s^{-1}.

24590 Rovibrational excitation within the infinite conical well: desorption of diatomic molecules. Gadzuk, J.W.; Landman, U.; Kuster, E.J.; Cleveland, C.L.; Barnett, R.N. (National Bureau of Standards, Washington, DC). *Journal of Electron Spectroscopy and Related Phenomena;* **30**: 103-110(1983). Contract AS05-77ER05489.

An analytic model for the hindered rotational states of a diatomic molecule adsorbed upright on a solid surface is discussed. Various model dynamics situations, within the sudden approximation, designed to simulate desorption are presented and rotational state distributions are calculated including both rotational and translational degrees of freedom. Criteria are established for observing rotationally cool desorbed molecules.

24591 Resonance photoelectron spectroscopy of 5p hole states in atomic barium. Kobrin, P.H.; Rosenberg, R.A.; Becker, U.; Southworth, S.; Truesdale, C.M.; Lindle, D.W.; Thornton, G.; White, M.G.; Poliakoff, E.D.; Shirley, D.A. (Lawrence Berkeley Lab., CA). *Journal of Physics B: Atomic and Molecular Physics;* **16**: 4339-4349(1983). Contract AC03-76SF00098.

Photoelectron spectra of atomic barium have been recorded at several photon energies in the range $20 \leq h\nu \leq 29$ eV. The variations of the Ba^+ $5p^6nl$ (nl = 6s, 5d, 6p, 7s, 6d) photoelectron peak intensities were measured in the 20-21 eV autoionization region. The results indicate that each autoionizing state decays to the various states of the ion in a characteristic way. Asymmetry parameters measured for the 6s, 5d and 6p channels show strikingly different values that follow the general trend $\beta(6s) > \beta(6p) > \beta(5d)$. Above 21 eV, 5p ionization begins to dominate, and the Auger spectra were used to monitor the production of the various 5p hole states. As the photo energy is scanned across the autoionizing resonances, these Auger spectra indicate that excitation of 5p hole states decaying by two-step autoionization is the dominant mode in the production of very-low-energy photoelectrons ($\leq$ eV) and their corresponding high-energy Auger electrons. Calculations suggest that a heretofore unobserved $5p^56p^2$ ^2P/sub 3/2/5d au-

toionizing level is responsible for the Auger distribution measured at hv = 28.9 eV.

24592 **Spectra of Ne K/sub α/ x-ray satellites and hypersatellites excited by 1.2-1.4 MeV amu^{-1} He, C, Mg and Ar ions.** Watson, R.L.; Benka, O.; Parthasaradhi, K.; Maurer, R.J.; Sanders, J.M. (Texas A & M Univ., College Station). *Journal of Physics B: Atomic and Molecular Physics;* **16**: 835-851(1983).

The spectra of Ne K x-rays excited by beams of 4.7 MeV He ions, 16.7 MeV C ions, 32.4 MeV Mg ions and 54.0 MeV Ar ions have been measured with a curved crystal spectrometer. A detailed analysis of the multiplet line structure contributing to the K/sub α/ satellites and hypersatellites was performed and comparisons with the experimental spectrum excited by C ions yielded quite good agreement with the theoretical predictions. The correspondence of the ratios of the hypersatellite to satellite relative intensity ratios to those predicted by the ratios of the average theoretical fluorescence yields was investigate. The dependence of the average L-vacancy fraction for Ne on the ratio of the projectile velocity to average charge was extended beyond the region previously explored and large deviations from the original linear function were found. 30 references, 7 figures.

24593 **Theoretical determination of the crystalline packing of chain molecules.** Tripathy, S.K.; Hopfinger, A.J.; Taylor, P.L. (Case Western Reserve Univ., Cleveland, OH). *Journal of Physical Chemistry;* **85**: 1371-1380(1981).

A general method is presented to minimize the packing energy of a polymer crystal. The polymer chain conformation is fixed so that the corresponding lattice can be decomposed into rows of atoms possessing the periodicity of the conformational repeat unit. A set of expressions is derived to compute the interaction energy of each unique row of atoms, treated as periodic force centers, with an atom not belonging to the lattice generated by the set of row atoms. The total energy is assumed to be the pairwise additive sum of atomic interactions expressed in terms of inverse powers of interaction distances by using classical Lennard-Jones-type dispersive-repulsive and Coulomb-type electrostatic potential functions. Mathematical tractability is obtained by expanding the series sums with the periodicity of the row lattice in a Fourier series in terms of the reciprocal lattice vectors. Rapid convergence of these series facilitates truncation to desired accuracy. The packing energy, defined to be the interaction energy of a central conformational repeat unit interacting with a set of user-prescribed polymer chains, is minimized with respect to the unit cell parameters for an assumed symmetry. The chain packing of polyethylene and phase I of poly(vinylidene fluoride) (PVF_2) have been studied in detail to establish general criteria for investigating crystalline phases of polymers under arbitrary packing symmetry. Different proposed sets of potentials have been employed in the calculations and some comments are presented regarding the choice of the set of potentials.

24594 **Surface-enhanced Raman scattering (SERS) by molecules adsorbed at spherical particles: errata.** Kerker, M.; Wang, D.S.; Chew, H. (Clarkson Coll. of Tech., Potsdam, NY). *Applied Optics;* **19**: No. 24, 4159-4174(15 Dec 1980).

A model for Raman scattering by a molecule adsorbed at the surface of a spherical particle is articulated by treating the molecule as a classical electric dipole. This follows Moskovits's suggestion [J. Chem. Phys. 69, 4159 (1978)] and the experiments by Creighton et al. [J. Chem. Soc. Faraday Trans. II, 75, 790(1979)] that such a system may exhibit SERS simlar to that at roughened electrode surfaces. The molecule is stimulated by a primary field comprised of the incident and near-scattered fields. Emission consists of the dipole field plus a scattered field, each at the shifted frequency. Addition of feedback terms between the dipole and the particle makes only a negligible contribution to the fields. For pyridine adsorbed at the surface of a silver sphere, the 1010 cm^{-1} band is enhanced by $\sim 10^6$ if the radius is much less than the wavelengths and the excitation wavelength is ~382 nm, a wavelength for which the relative refractive index of silver is close to m = $\sqrt{2}$i. Detailed results are given for the effect upon the angular distribution and the polarization of the Raman emission of particle size, distance from the surface, excitation wavelength, and location of the molecule upon the surface. These results simulate those observed at roughened silver electrodes and suggest that the mechanism of SERS at those electrodes may resemble the electromagnetic mechanism elucidated here. The authors predict that comparable effects should be observed for fluorescent scattering. 53 references, 9 figures.

24595 **Raman and fluorescent scattering by molecules embedded in dielectric cylinders.** Chew, H.; Cooke, D.D.; Kerker, M. (Clarkson Coll. of Tech., Potsdam, NY). *Applied Optics;* **19**: 44-52(1 Jan 1980).

Fluorescent and Raman scattering by molecules embedded in dielectric particles is strongly dependent on the morphology and optical properties of the particle and the distribution of active molecules within the particle. In this paper, the formalism is derived for the case where the scattering molecules are embedded in an infinite dielectric cylinder. Analytical results for the scattered fields are given for arbitrary angles of incidence. The general results, which involve an integral and a sum, are rather lengthy. Accordingly, the saddle-point method has been used to carry out the integration approximately. Numercial results are given for perpendicular incidence and for observation in the plane perpendicular to the cylinder axis, for single dipoles variously located within the cylinder and for a uniform distribution of isotopic incoherent dipoles. The angular distribution and polarization of the scattered irradiance depends sensitively upon cylinder radius and refractive index, so that this effect must be considered if inelastic scattering signals are to be used as a diagnostic tool. 14 references, 12 figures.

24596 **Raman and fluorescent scattering by molecules embedded in small particles: numerical results for incoherent optical processes.** Kerker, M.; McNulty, P.J.; Sculley, M.; Chew, H.; Cooke, D.D. (Clarkson Coll. of Tech., Potsdam, NY). *Journal of the Optical Society of America;* **68**: No. 12, 1676-1686(Dec 1978).

When molecules that give rise to Raman and fluorescent light scattering are distributed within small dielectric particles, the signal is affected by the morphology and optical properties of the particle, and the distribution of molecules of interest within it. These effects are manifested by changes in the magnitude, in the angular distribution, and in the polarization of the scattered radiation. Furthermore, because the effects vary with the wavelengths of both the exciting and the emitted radiation, the emission spectrum for fluorescence may vary with the exciting wavelength, the morphology and optical properties of the particle, the distribution of the active molecules within the particle, and even the angle of observation. These phenomena must be considered in quantitative procedures for utilizing Raman and fluorescent scattering for determining the concentration of specific molecules in small particles such as aerosols or biological cells. The effects are illustrated here by a series of numerical calculations involving inelastic noncoherent scattering by molecules variously embedded in dielectric spheres. 6 references, 19 figures.

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REFER ALSO TO CITATION(S) 25055

24597 **(IC—84/126) Microscopic approach to critical behaviour in ^{3}He-^{4}He mixtures (II). Thermodynamics of the effective Hamiltonian.** Singh, K.K.; Goswami, P. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1984. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700516.

Thermodynamics of a weakly interacting fermion-boson mixture has been worked out on the basis of the effective Hamiltonian derived in an earlier paper. Tricritical point behaviour is discussed in terms of the fields (T,μ_3,μ_4). For the degenerate phase of the mixture, the theory reproduces the classical Landau expansion near a tricritical point. For the non-degenerate phase, the theory differs materially from the Landau theory; it predicts tricritical exponents in agreement with those calculated by applying renormalization group theory to phenomenological models, and a slope for the upper line larger than that of the lambda-line in the chi-T plane.

24598 **(INIS-mf—9500) Separable interactions and liquid ^{3}He.** Nijhoff, F.W. (Rijksuniversiteit Leiden (Netherlands)). 2 May 1984. 184p. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780832.

Includes Dutch summary.

In this thesis, the different phases of liquid ^{3}He are studied in the presence and absence of magnetic field. It offers microscopic calculations starting from BCS Hamiltonians with some additional terms (Zeeman-term to include the magnetic field; an Hubbard-term to include spin fluctuations). A systematic determination of the phase diagram is presented.

24599 **(UCID—20406) Applications of Canuto's method to Rayleigh-Taylor-initiated turbulence.** Alonso, C.T. (Lawrence Livermore National Lab., CA (USA)). 28 Feb 1985. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010835.

The recently published method of Canuto and Goldman for estimating large-scale turbulent energies from instability growth rates has been applied to Rayleigh-Taylor-initiated turbulence. Simple closed expressions were derived for the kinetic energy spectrum of turbulent eddies and the total kinetic energy. The results depend very much on the smallest realizable wavenumber; that is, all the energy lies in the largest eddies. Calculations based on this model indicate that for systems of the order of centimeters, the total turbulent kinetic energy density can be considerably greater than the translational kinetic energy of the perturbed interface, for interface velocities of the order of a few cm/sec or greater. Thus, the turbulent energy substantially impacts the energy balance of such systems. Applications exist in many laboratory and astrophysical cases of general interest.

24600 **Two and three particle distribution functions of one-dimensional lattice fluids.** Johnson, E. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Chemical Physics;* **82**: No. 8, 3779-3785(15 Apr 1985). Contract AC05-84OR21400.

A pair of exact equations are used to determine the two and three particle distribution functions of lattice fluids. The particles of a lattice fluid exclude one or more lattice sites and their positions are sites on a lattice. Accurate particle distribution functions are obtained. The major obstacle to obtaining accurate results seems to be computer round-off error. A procedure is given for circumventing this round-off problem.

24601 **Development of viscous fingering patterns.** Maher, J.V. (Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Physical Review Letters;* **54**: No. 14, 1498-1501(8 Apr 1985). Contract FG02-84ER45131.

The development of viscous fingering patterns has been observed from very early times to deep in the nonlinear regime for the flow of immiscible liquids in a Hele-Shaw cell. If the dimensionless viscosity contrast, A, is large, the number of fingers decreases rapidly with time after the initial pattern is established. If $A \approx 0$, all fingers grow through the entire time range of this experiment. For all values of A there is a power-law relation between the length of the longest finger and the time.

24602 **Stability analysis of two-dimensional models of three-dimensional convection.** Greenside, H.S.; Cross, M.C. (Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, New Jersey 08544). *Physical Review [Section] A: General Physics;* **31**: No. 4, 2492-2501(Apr 1985).

Analytical and numerical methods are used to study the linear stability of spatially periodic solutions for various two-dimensional equations which model thermal convection in fluids. This analysis suggests new model equations that will be useful for investigating questions such as wave-number selection, pattern formation, and the onset of turbulence in large-aspect-ratio Rayleigh-Benard systems. In particular, we construct a nonrelaxational model that has stability boundaries similar to those calculated for intermediate Prandtl-number fluids.

24603 **Discharge modes at the anode of a vacuum arc.** Miller, H.C. (General Electric Co., St. Petersburg, FL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science;* **PS-11**: No. 3, 122-127(Sep 1983). Contract AC04-76DP00656.

Five possible discharge modes can exist at the anode of a vacuum arc. The two most common anode modes are a low current mode, where the anode is basically inert; and a high current mode with a fully developed anode spot. This anode spot is very bright, has a temperature near the boiling point of the anode material, and is a copious source of vapor and energetic ions. Three additional anode modes can occur in appropriate circumstances. A low current vacuum arc with electrodes of readily sputterable material will emit a flux of sputtered atoms from the anode. At intermediate currents, an anode footpoint can form. This footpoint is luminous, but much cooler than a true anode spot. Finally, a high current mode can exist where several small anode spots are present instead of a single large anode spot. 24 references, 1 figure, 2 tables.

24604 **Decay of correlations in the Lorentz gas.** Alder, B.J.; Alley, W.E. (Lawrence Livermore National Lab., CA). *Physica A (Amsterdam);* **121A**: 523-530(1983). Contract W-7405-ENG-48.

Computer molecular dynamics calculations give no support to the mode-coupling prediction that the power law of the asymptotic decay of the velocity autocorrelation function is independent of the density of the Lorentz scatters. 10 references, 4 figures.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 24650, 24672, 24761

24605 (CERN—84-09, pp 218) **Experimental observation of events with large missing transverse energy accompanied by a jet or a photon(s) in p anti p collisions at $\sqrt{s} = 540$ GeV.** Rubbia, C. (European Organization for Nuclear Research, Geneva (Switzerland)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Published in summary form only.

24606 (CERN—84-09, pp 142-164) **Production of high mass $e\nu$ and e^+e^- pairs in the UA2 experiment at the CERN anti pp collider.** Schacher, J. (Bern Univ. (Switzerland)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

We present new results on intermediate vector boson production at the CERN anti pp collider. A comparison is made with the predictions of the standard model of the unified electroweak Glashow-Salam-Weinberg theory.

24607 (CERN—84-09, pp 219-230) **Observation of electrons produced in association with hard jets and large missing transverse momentum in p anti p collisions at $\sqrt{2} = 540$ GeV.** Roussarie, A. 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Using a sample of events collected by UA2 and corresponding to an integrated luminosity of 116 nb^{-1}, we have searched for electron-'neutrino' pairs in which the transverse momenta of the electron and of the 'neutrino' exceed 15 GeV/c and 25 GeV/c respectively. A total of 35 events are observed in low background conditions. Most events can be interpreted in terms of W production from QCD processes. Four events in which the observation of hard jets makes this interpretation unlikely are described in detail. Possible sources of background contamination are considered.

24608 (CERN—84-09, pp 6-19) **Jets in the UA1 experiment.** Scott, W.G. (Science and Engineering Research Council, Chilton (UK). Rutherford Appleton Lab.; European Organization for Nuclear Research, Geneva (Switzerland)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

The UA1 two-jet cross-section based on the 1982 data has been published already. We review that data briefly here and make a few additional comments.

24609 (CERN—84-09, pp 20-45) **High Psub(T) jets from p anti p collisions at $\sqrt{s}$=540 GeV in UA2.** Hansen, J.R. 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

With 30 refs. .

The production and properties of very large transverse momentum hadron jets has been measured in the UA2 experiment at the CERN anti pp Collider for vs = 540 GeV using a highly segmented calorimeter. Events with very large transverse energy depositions (ΣEsub(T) up to 250 GeV in the pseudo-rapidity interval -1 < eta < 1) are observed to be strongly dominated by a two-jet structure. Some of the characteristics of parton scattering and fragmentation are discussed and cross-sections for inclusive jet production is presented for psub(T) up to 150 GeV. The two-jet invariant mass distribution up to msub(jj) = 280 GeV is shown and the results are compared with the predictions of QCD models. A search for bumps in the msub(jj) distribution is reported.

24610 (CERN—84-09, pp 114-131) **Recent results from high transverse momentum processes at the ISR.** Geist, W.M. (European Organization for Nuclear Research, Geneva (Switzerland)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Various aspects of three ISR experiments on deep inelastic phenomena are discussed. New data on inclusive production at high transverse momentum of protons give first experimental evidence for hard diquark scattering. Measurements of deep inelastic production of single kaons and jets and rather detailed analyses of jet structures and of correlations between jets are presented. The experimental findings are consistently explained in terms of hard scattering of quarks and gluons. Finally, it is shown that a precise measurement of central particle production in these hard scattering events could reveal the prevailing fragmentation mechanism of systems of coloured partons.

24611 (CERN—84-09, pp 232-236) **Dsup(*+-) production at the CERN SPS collider.** Frey, R. (California Univ., Riverside (USA)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

We report evidence for the production of the charged Dsup(*) mesons in anti pp collisions at $\sqrt{s}$ = 540 GeV. The search was confined to the charged particle fragments of hadronic jets. Preliminary results for the fragmentation function and production rate for Dsup(*) are given.

24612 (CERN—84-09, pp 286-305) **New results from UA5: Strange particle (K^0, Λ, $>^-$) production and large fluctuations in multiplicities.** Carlson, P. 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Preliminary results are presented from about 6500 non single diffractive minimum bias events taken with the UA5 streamer chambers at the collider with a beryllium beam pipe. Significantly increased statistics on V^0 production has permitted the first observation of $>^-$ as well as a more accurate estimate of the average transverse momentum of Ksub(S)^0 and Λ. The non single diffractive multiplicity distribution has been studied in detail and revealed non scaling behaviour. In very narrow rapidity intervals large fluctuations, 'spikes', in multiplicity occur.

24613 (CERN—84-09, pp 324-341) **Physics with antiprotons at LEAR.** Kilian, K. (European Organization for Nuclear Research, Geneva (Switzerland). EP-Div.). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

The low energy antiproton ring LEAR started to work at CERN in 1983. It provides clean anti p beams of much higher intensity and much better quality than available so far in the range from 0.1 to 2 GeV/c momentum. 16 of the 17 accepted experiments are installed and 14 of them took first data in 1983. After approx.= 240 hours of LEAR operation very first results are available. One can expect that exciting physics results be produced in many different domains provided LEAR gets enough anti p in the future.

24614 **(DOE/ER/03072—30) Forward production of high mass muon pairs in pion-nucleon interactions.** Palestini, S. (Princeton Univ., NJ (USA). Elementary Particles Lab.). Dec 1984. Contract AC02-76ER03072. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85008684.

The production of muon pairs in negative pion nucleon interactions has been studied at a center-of-mass energy of 12.2 GeV. About 4000 events have been collected over a broad range of longitudinal momentum and invariant mass. A comparison with the Drell-Yan Model has been made, confirming the factorization hypothesis. The results favor a non-vanishing value of the pion structure function at the kinematic limit of large longitudinal momentum. Other departures from the standard parton-QCD model are found in this region. The angular distribution of the muon pair becomes characteristic of longitudinal virtual photon polarization, and the transverse momentum of the pair is found to decrease. 39 refs., 70 figs., 21 tabs..

24615 **(IFVE-OEF—83-16) Large transverse momentum single and pair hadron production in proton and π-meson beams. FODS-2 experiment proposal.** Abramov, V.V.; Alekseev, A.V.; Baldin, B.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 32p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700856.

Possibilities for further development of the program on investigation of hadron collision at the IHEP accelerator have been considered. The experiments on single and pair production of hadrons with large Psub(perpendicular) in intense proton and pion beams have been proposed and reasoned. A two-arm FODS-2 spectrometer with large aperture and wide scale capabilities for charged and neutral hadron detection in wide production angular range has been designed for this purpose. Its description is given here also.

24616 **(IFVE-OEF—83-155) X-particle production in πp p collisions at 38 GeV/c.** Binon, F.; Guanehr, M.; Donskov, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700855.

Submitted to the journal Sov. J. Nucl. Phys.

The chi-particle production has been studied in reaction π^- +p→chi+ ... in the near threshold region. The experiments have been performed at the 70 GeV IHEP accelerator with the hodoscope spectrometer GAMS-2000. The chi-particles are identified after their decay chi→J/psi+γ, J/psi→e^+e^-. In the studied region, Xsub(F)< or approximately 0.4. where Xsub(F)=Psub(e)/Psub(e, max) (Psub(e) is a longitudinal momentum of chi or J/psi-particles in the c.m.s. reactions) (44+chi-16)% of J/psi are produced through decay. The chi distributions on logitudinal and transverse momenta are analogous to those obtained for J/psi. The cross section of inclusive chi production ($^3P_1$ and $^3P_2$ states) at 38 GeV/c is found to be σ_0 p(π^- chi→ n+...)=(28+-11)b.

24617 (IFVE-OEIPK—83-153) Inclusive Ksup(*+)(890), Ksup(*+)(1430) and anti Ksup(*-)(890) production in K⁺p interactions at 32 GeV/c. Azhinenko, I.V.; Belokopytov, Yu.A.; Borovikov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700857.

Submitted to the journal Nucl. Phys., B.

Relative probabilities of strange vector and pseudoscalar meson formation turn out to be different for neutral and positively charged particles constituting K* deg (890) prompt/K deg prompt=0.98+-0.17 and K*+ (890) prompt/K+ prompt=0.59+-0.06 at 32 GeV/s. The Lund model well describes the form of inclusive, half-inclusive and double-differential distributions K*+ (890) by transverse momenta if the value 0.62-0.70 GeV/s is used instead of presupposed in the model value of standard deflection in Gauss distribution of transverse momenta of sea quarks σsub(p)=0.44 GeV/s.

24618 (INIS-mf—9264) Study of multimuon-final states in deep inelastic neutrino scattering. Renk, B. (Dortmund Univ. (Germany, F.R.). Abt. Physik). 3 Feb 1984. 137p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780837.

In this thesis the measurement of the momentum spectra, angular correlations, and transverse momentum distributions of the secondary muons produced in deep inelastic neutrino scattering at the CERN 300 GeV narrow band neutrino beam is described. From the experimental results conclusions are drawn about neutrino oscillations and the quantum numbers of charm-violating neutral currents. Furthermore upper limits for the momentum part of the c quark in the nucleon, and the fragmentation function for c quarks at high energies were determined. The prompt $\mu^-\mu^-$ events are interpreted as pair production of charmed particles. Finally dimuon events induced by axions were looked for.

24619 (JINR—1-83-912) Observation and investigation of narrow state in Σp(1385)K⁺ system. Aleev, A.N.; Aref'ev, V.A.; Balandin, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700859.

New data on the production and the investigation of a narrow resonance decaying into Σ⁻(1385)K⁺ are obtained. The mass of the resonance is 1956sub(-6)sup(+8) MeV/c² and its width is 14+-12 MeV/c². The resonance is produced in a diffraction dissociation process of neutrons on quasi-free nucleons of carbon nuclei. The slope parameter of the Psub(T)sup(2) differential cross section is equal to 9.9+-3.0 (GeV/c)⁻². The partial cross section times the branching ratio is 0.22+-0.04 μb per nucleon. The resonance has one of the natural spin-particles: $5/2^+$, $7/2^-$.

24620 (JINR-D—1-83-865) Λsub(c)sup(+) baryon production in interactions of 40-70 GeV neutrons with carbon nuclei. Aleev, A.N.; Aref'ev, V.A.; Balandin, V.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700543.

Submitted to the journal Z. Phys., C. Includes original document in Russian.

The inclusive production of charmed baryons Λsub(c)sup(+) by 40-70 GeV neutrons on carbon has been observed. The decays Λsub(c)sup(+) → anti $K^0p\pi^+\pi^-$ (130+-18 events) and Λsub(c)sup(+) → $\Lambda^0\pi^+\pi^+\pi^-$ (57+-14 events) have been detected. The mean value of Λsub(c)sup(+) mass is (2268+-6) MeV/c². The product of cross sections of the Λsub(c)sup(+) inclusive production measured for $x > 0.5$ and the branching ratios are σxB(anti $K^0p\pi^+\pi^-$)=(10+-4) μb per carbon nucleus and σxB($\Lambda^0\pi^+\pi^+\pi^-$)=(2.3+-1.1) μb per carbon nucleus. The experiment has been performed in the neutron beam of the Serpukhov accelerator using the spectrometer BIS-2.

24621 (JINR-R—1-84-79) Quark and diquark fragmentation into strange particles in πpp interactions at p=40 GeV/c. Grishin, V.G.; Didenko, L.A.; Karnaukhov, V.M.; Koka, K.; Kuznetsov, A.A.; Metreveli, Z.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1984. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700858.

Submitted to the journal Sov. J. Nucl. Phys.

The quark and diquark fragmentation into neutral kaons and Λ-hyperons in soft hadron-hadron interactions are studied. The fragmentation function is analyzed. The obtained data are compared with results on e^+e^--interactions. It is shown that the FF for neutral kaons and Λ-hyperons is scaling within the experimental errors for the diquark hadron interactions in the energy fragmentation in the hadron- range 16-405 GeV/c. The dependence of quark and diquark (FF) of xsub(E) for neutral kaons and Λ-hyperons are similar to those in e^+e^--annihilation. The pick up probability of strange s(anti s)-quark (lambdasub(s)) and diquark (lambdasub(qq)) relative to u(anti u) and d(anti d)-quark from the sea has been determined to be: lambdasub(s)=0.17, lambdasub(qq)=0.14+-0.03. The obtained results indicate that the quark and diquark fragmentations into strange particles in soft hadron-hadron and e^+e^--interactions are universal.

24622 (KEK—82-8, pp 1-5) Measurement of electron neutrino mass by means of the orbital electron capture process. Yasumi, Shinjiro; Ochiai, Fumio; Ikeda, Hirokazu (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1982. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780011. (CONF-8203187—).

From 4. workshop on the mass of the electron neutrino; Oho, Ibaraki, Japan (27 Mar 1982).

An attempt was made to measure electron neutrino mass on the basis of the process of internal bremsstrahlung electron capture. In this paper, a preliminary experiment on electron capture as well as the outline of the whole plan on the measurement of neutrino mass are described. A Ho-163 source was selected as a radiator, and was produced by the irradiation of an enriched Dy-164 metal target with proton beam using the Dy-164 (p, 2n) Ho-163 reaction. In order to find out a Q-value for electron capture and the half-life of Ho-163, the photon spectra from a Ho-163 source were measured with a Si(Li) detector using a 0.3-mil Be window. From the measured absolute intensity of a (5p-3s) characteristic X-ray line, the Q-value for zero neutrino mass was obtained to be 2.137 keV. The half-life of Ho-163 was estimated to be about 320 years.

24623 (KEK—83-15) Proceedings of the 7th workshop on the mass of the electron neutrino. Yasumi, Shinjiro (ed.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1983. 73p. (In Japanese). (CONF-8303183—). NTIS (US Sales Only), PC A04/MF A01. File Number DE85700854.

From 7. workshop on the mass of the electron neutrino; Oho, Ibaraki, Japan (24 Mar 1983).

The 7th workshop on the mass of electron neutrino was held at KEK on March 24, 1983. Discussions at the workshop were made concerning the methods to make dysprosium targets for the production of a Ho-163 electron capture source, the measurement of Ho-163 atoms by the PIXE (particle induced X-ray emission) method, the intensity and spectrum measurements of low energy X-ray, the accuracy of measurement of neutrino mass, the estimation of the M-shell photoelectron effect of Dy, the proposal on the accurate measurement of the Q-value of Ho-163 decay, the study of the M-shell of Dy atoms using monochromatic X-ray, and the manufacture of windowless Si(Li) detectors. The positive promotion of the approach by non-radiative process is necessary. For the purpose, the precise measurements of the absolute intensity of MX-ray and the atoms of Ho-163 are required. The manufacture of clean and pure Ho-163 sources may be necessary. A method of measuring the Q-value of Ho-163 through a nuclear reaction and a study of the atomic process associated to the electron hole production in the M-shells are proposed.

24624 (LBL—18820) Inclusive hadron production and two particle correlations in e^+e^- annihilation at 29 GeV center-of-mass energy. Shapiro, M. (Lawrence Berkeley Lab., CA (USA)). Dec 1984. Contract AC03-76SF00098. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85009956.

We have studied hadron production in e^+e^- annihilation at 29 GeV center-of-mass energy using the PEP-4 Time Projection Chamber Detector. The inclusive cross sections and mean multiplicities for π^{+-}, K^{+-} and (p + anti p) production have been measured using ionization energy loss to separate particle species. We find on average 10.7 +- 0.6 π^{+-}, 1.35 +- .13 K^{+-} and 0.60 +- 0.08 (p + anti p) per multihadron event. The differential cross section is well described by a number of Monte Carlo hadronization models. In addition, we have observed correlations in rapidity space for identified pions and kaons. Short-range KK correlations provide evidence for local flavor compensation during hadronization. Long-range $\pi\pi$ and KK correlations indicate that the initial partons carry flavor. We also observe significant long-range πK correlations as a result of heavy quark decays. 85 references, 67 figures, 11 tables.

24625 (SLAC-PUB—3589) Selected topics from J/psi decays. Odian, A. (Stanford Linear Accelerator Center, CA (USA)). Feb 1985. Contract AC03-76SF00515. 4p. (CONF-8410222—19). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010537.

From American Physical Society meeting; Santa Fe, NM, USA (31 Oct 1984).

Branching ratios for J/psi radiative decays are given, and the spin parity assignments for iota and $\theta(1640)$ were determined to be 0^- and 2^+, respectively. (WHK)

24626 Search for single photons from supersymmetric particle production. Fernandez, E.; Ford, W.T.; Qi, N.; Read A.L. Jr.; Smith, J.G.; Camporesi, T.; De Sangro, R.; Marini, A.; Peruzzi, I.; Piccolo, M.; Ronga, F.; Blume, H.T.; Hurst, R.B.; Venuti, J.P.; Wald, H.B.; Weinstein, R.; Band, H.R.; Gettner, M.W.; Goderre, G.P.; Meyer, O.A.; Moromisato, J.H.; Polvado, R.O.; Shambroom, W.D.; Sleeman, J.C.; von Goeler, E.; Ash, W.W.; Chadwick, G.B.; Clearwater, S.H.; Coombes, R.W.; Kaye, H.S.; Lau, K.H.; Leedy, R.E.; Lynch, H.L.; Messner, R.L.; Moss, L.J.; Muller, F.; Nelson, H.N.; Ritson, D.M.; Rosenberg, L.J.; Wiser, D.E.; Zdarko, R.W.; Groom, D.E.; Lee, H.Y.; Delfino, M.C.; Heltsley, B.K.; Johnson, J.R.; Lavine, T.L.; Maruyama, T.; Prepost, R. (Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review Letters;* **54**: No. 11, 1118-1121(18 Mar 1985). Contract AC02-81ER40025;AC03-76SF00515;AC02-76ER00881.

A search in e^+e^- annihilation for final states which contain only a single energetic photon has been performed at $\sqrt{s}$ = 29 GeV with the MAC detector at PEP. The upper limit on an anomalous signal has been interpreted in terms of mass limits for supersymmetric particles under the assumption of radiative pair paroduction of either supersymmetric photons or neutrinos. For the supersymmetric electron (e) this limit is m/sub e/>37 GeV/c^2 at the 90% confidence level if M/sub e//sub L/ = m/sub e//sub R/ and the supersymmetric photo (gamma-tilde) has m/sub gamma-tilde/ = 0.

24627 Charged D/sup / production in e^+e^- annihilation at 29 GeV and a limit on D^0-D-bar ^{0} mixing. Yamamoto, H.; Atwood, W.B.; Baillon, P.H.; Barish, B.C.; Bonneaud, G.R.; Courau, A.; Donaldson, G.J.; Dubois, R.; Duro, M.M.; Elsen, E.E. (California Institute of Technology, Pasadena, California 91125 and Stanford Linear Accelerator Center and Physics Department, Stanford University, Stanford, California 94305). *Physical Review Letters;* **54**: No. 6, 522-525(11 Feb 1985). Contract AC03-76SF00515;AC03-81ER40050.

We have studied inclusive D/sup asteriskplus-or-minus/ production using the DELCO detector at PEP. Our technique involved kaon identification in the momentum range above 3.2 GeV/c using a threshold gas Cerenkov counter. This leads to a model-independent upper limit on D^0-D-bar ^{0} mixing of 8.1% (90% confidence level). We also have measured the charm fragmentation function, which peaks at xequivalentP/sub D/(/(E/sub beam/^{2}-M* ^{2})/sup 1/2/ of 0.56 +- 0.06(stat.), and the total cross section for D(production, σ(D/sup asteriskplus-or-minus/) = 0.140 +- 0.021(stat.) +- 0.032(syst.) nb (x > 0.3, with radiative correction).

24628 Measurement of the real-to-imaginary ratio of the p-barp forward-scattering amplitudes. Ashford, V.; Sainio, M.E.; Sakitt, M.; Skelly, J.; Debbe, R.; Fickinger, W.; Marino, R.; Robinson, D.K. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **54**: No. 6, 518-521(11 Feb 1985). Contract AC02-76CH00016.

We have measured the ratio of the real to the imaginary parts of the p-barp forward-scattering amplitude in the incident-momentum range 360 to 650 MeV/c. These results are in good agreement with predictions of the Paris nucleon-antinucleon potential model which include spin-flip effects.

24629 Searches for rare decays of the muon and for μe conversion as experimental tests of muon number conservation. Nagle, D.E. (Los Alamos National Lab., NM). *Comments on Nuclear and Particle Physics;* **11**: No. 6, 277-286(1983).

A brief overview is presented of the present experimental situation regarding sensitive tests of muon-electron number conservation, together with some salient implications.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 24709, 24720, 24720, 24725

24630 (CERN—84-09) 4. topical workshop on proton-antiproton collider physics. Proceedings. Haenni, H.; Schacher, J. (eds.). (European Organization for Nuclear Research, Geneva (Switzerland)). 8 Aug 1984. 594p. (CONF-8403130—). NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841.

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

The most exciting topic at this Workshop was clearly the experimental hint for new unexpected phenomena, reported by the UA1 and UA2 Collaborations: At the CERN SPS Collider (vs = 540 GeV), a few events were observed with high missing transverse energy in association with an isolated electromagnetic cluster or one or more hard jets (UA1) or an isolated electron and one or two hard jets (UA2). Due to the enhanced data sample, the discovery of the intermediate vector bosons W and Z in 1983 was undoubtedly confirmed, and the nice agreement of their properties with the predictions of the electroweak theory was shown. In addition, many new results on experimental and theoretical jet physics were presented. The Tevatron Collider project and its planned experiments at Fermilab were discussed, and there were contributions about the possible future developments in theory (compositeness, supersymmetry) as well as in experimental high energy physics (Supercollider, Juratron). See hints under the relevant topics.

24631 (CERN—84-09, pp 165-180) Electroweak interaction parameters. Marciano, W.J. (Brookhaven National Lab., Upton, NY (USA)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—). Contract AC02-76CH00016.

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Also published as report BNL--34728; CONF-8403130--1.

After a presentation of the experimentally determined parameters of the standard SU(3) x SU(2) x U(1) model the author discusses the definition of the Weinberg angle. Then masses and widths of the intermediate vector bosons are considered in the framework of the Weinberg-Salam theory with radiative corrections. Furthermore the radiative decays of these bosons are discussed. Then the relations between the masses of the Higgs boson and the top quark are considered. Thereafter grand unification is briefly discussed with special regards to the SU(5) prediction of some observable parameters. Finally some speculations are made concerning the observation of radiative decays in the UA1 experiments.

24632 (CERN—84-09, pp 181-201) **(Wsup(+-), Z): Production from p anti p and decay.** Minkowski, P. (Bern Univ. (Switzerland). Inst. fuer Theoretische Physik). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Electroweak parameters at the scale of 100 GeV are presented and put to work in the calculation of cross sections for W and Z production from p anti p collisions.

24633 (CERN—84-09, pp 202-208) **QCD psub(T) effects in W/Z and jet production.** Greco, M. (Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Theoretical aspects of transverse momentum distributions in QCD are discussed in connection to weak bosons and dijet production at Sp anti pS collider energies.

24634 (CERN—84-09, pp 237-259) **Weak mixing angles and heavy flavours.** Jarlskog, C. (Stockholm Univ. (Sweden). Fysiska Institutionen). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

With 58 refs. .

The present status of the weak mixing angles, in the standard six quark model, is reviewed. The implications of the recent measurements of the beauty lifetime and branching ratios are discussed, in the framework of the Kobayashi-Maskawa and the Wolfenstein parametrizations. Expectations for B^0-anti B^0 mixing and consequences for the collider data are given. Other topics briefly reviewed are CP-violation, top quark mass and possible implications of the existence of a fourth family.

24635 (CERN—84-09, pp 276-284) **Minimum mass technique for detecting new heavy states in high energy hadron collisions.** Stirling, W.J. (European Organization for Nuclear Research, Geneva (Switzerland)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Many predicted heavy states are expected to decay frequently into three or more body final states in which at least one particle, such as a neutrino or photino, is non-interacting. A method is described for obtaining estimates of both the mass and the longitudinal momentum of the parent state. Two applications - the decay of top quark hadrons and gluinos (in the R symmetry scheme) - are discussed in detail.

24636 (CERN—84-09, pp 474-482) **Higgs scalars and alternatives.** Wyler, D. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Theoretische Physik). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

With 37 refs. .

We turn to the description of the relevant interactions of elementary and composite scalars and then to possible production mechanisms.

24637 (CERN—84-09, pp 209-215) **Testing the WWsub(γ) coupling of the Glashow-Salam-Weinberg model at p anti p colliders.** Cortes, J. (European Organization for Nuclear Research, Geneva (Switzerland). Theory Div.); Hagiwara, K.; Herzog, F. (Wisconsin Univ., Madison (USA). Dept. of Physics). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—). Contract AC02-76ER00881.

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

We propose methods to measure the anomalous magnetic moment K of the W-boson, a quantity which is of foremost importance for testing the non-abelian structure of the electroweak gauge theory.

24638 (CERN—84-09, pp 46-83) **Jet topologies in hadron-hadron collisions.** Field, R.D. (Florida Univ., Gainesville (USA). Dept. of Physics). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—). Contract AS05-81ER40008.

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Event topologies in pp collisions at W = 60 GeV and in anti pp collisions at W = 540 GeV resulting from a QCD Monte-Carlo model are examined. The model includes gluon radiation both in the initial and final states and the outgoing hadrons are labeled according to whether they arise before or after the hard parton-parton collision. Transverse energy flows and transverse energy grids are studied with emphasis, not on 'jet finding', but on the patterns of energy deposition. These patterns are quantified by examining the multiplicity of transverse energy clusters each of which has energy greater than some fixed amount. At high transverse energy the model produces events that are slightly less 'two-jet' like than the UA2 data. However, the predicted frequency of occurrence of three cluster events is in good agreement.

24639 (CERN—84-09, pp 84-101) **Comparison of quark and gluon jets.** Schierholz, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Also published as report DESY--84-056.

If QCD is the underlying theory of the strong interactions, quark and gluon jets should appear to be rather different in nature. In this talk I discuss the (theoretical) roots of this difference and to what extent it has been borne out experimentally.

24640 (CERN—84-09, pp 102-107) **Triple and quadruple jets.** Kunszt, Z. (Bern Univ. (Switzerland). Inst. fuer Theoretische Physik). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

The parton model description of three and four jet production in proton-antiproton collisions is shortly reviewed. Four heavy quark production is also discussed.

24641 (CERN—84-09, pp 108-113) **Jets: What we can still learn ...** Humpert, B. (Lausanne Univ. (Switzerland). Inst. de Physique Nucleaire); Odorico, R. (Bologna Univ. (Italy). Ist. di Fisica; Istituto Nazionale di Fisica Nucleare, Bologna (Italy)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

A short overview is given about ongoing theoretical analyses concerning large- and low-psub(t) jet (j) production. A new class of (4-parton) processes, with two short-distance processes taking place simultaneously, is introduced, and cross-section estimates are given for: (4j)-, (W^+jj)-, and (WW)-production. The size of the (2-parton) 2j-..,6j- cross sections (also with W,Z) is determined. The importance of coincidence measurements between large- and low-psub(t) jets is stressed.

24642 (CERN—84-09, pp 132-140) **Transverse momentum distributions of jets and weak bosons.** Ellis, R.K. (Fermi National Accelerator Lab., Batavia, IL (USA)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Also published as report FERMILAB-Conf-84/49-T; CONF-8403130-3.

The theoretical description of processes leading to events at large transverse momentums is reviewed. Numerical estimates are given for jet cross-sections and for W and Z production cross-sections. The influence which uncertainties in the input parameters have on the theoretical predictions is also discussed.

24643 (CERN—84-09, pp 260-275) **Search for new flavours.** Halzen, F. (Wisconsin Univ., Madison (USA). Dept. of Physics); Martin, A.D. (Durham Univ. (UK). Dept. of Physics). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

With 31 refs. .

We discuss the search for new quark flavours with anti pp colliders. We emphasize the following subjects: (a) production cross sections: central and 'diffractive' production, heavy flavours in jets, (b) production of same and opposite sign dileptons, (c) signatures of heavy flavour production.

24644 (CERN—84-09, pp 308-313) **Elastic scattering.** Martin, A. (European Organization for Nuclear Research, Geneva (Switzerland). Forschungsabteilung Theoretische Physik). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

I present here theoretical comments on experiments for the high-energy behaviour of proton-antiproton scattering at collider energies.

24645 (CERN—84-09, pp 314-321) **New shape-effects in proton-antiproton elastic scattering.** Henzi, R. (McGill Univ., Montreal, Quebec (Canada)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

I summarize the arguments leading to the discovery of the BEL effect, and present some diffraction-theoretical predictions for future measurements, especially at supercolliders.

24646 (CERN—84-09, pp 442-455) **Supercollider physics.** Hinchliffe, I. (Lawrence Berkeley Lab., CA (USA)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Also published as report LBL--17719; CONF-8403130--2.

This talk is concerned with the physics opportunities of an extermely high energy proton-proton or proton anti-proton machine.

24647 (CERN—84-09, pp 519-525) **Gluino mass and CP violation in supersymmetric models.** Masiero, A. (European Organization for Nuclear Research, Geneva (Switzerland)). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

We consider the 'old' phenomenon of CP violation in the K^0-anti K^0 system which has recently received a considerable amount of interest in view of the unexpectedly long B lifetime. Being the SUSY contribution dominated by gluino (g tilde) and squark (q tilde) insertions in the box diagram, we find it appropriate to start by summarizing our knowledge on the gluino mass which plays a discriminatory role among different SUSY models.

24648 (CERN—84-09, pp 502-518) **Excited fermions.** Tancheri, G. (Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

Theoretical and experimental implications of the existence of excited states of ordinary leptons and quarks are examined. The contribution of excited electrons and of their neutral partners to the decays $Z_0 \rightarrow e^+ e^- \gamma$ and $Z_0 \rightarrow \nu\text{anti}\ \nu\ \gamma$ are discussed. Signatures of excited quark states are compared with reported experimental observations. Through weak isospin invariance, it is also found that there may exist excited quarks with weak isospin Isub(w) $>= 1$ which have exotic charge assignments and decay only electroweakly into ordinary quarks and leptons. These exotic quarks will give rise to charge +3 baryons and charge +- 2 mesons.

24649 (DOE/ER/40048—07-N4) **Summary of the discussion of the theory of radiative processes.** Miller, G.A. (Washington Univ., Seattle (USA). Dept. of Physics). 1984. Contract AC06-81ER40048. 4p. (CONF-8405299—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85007812.

From Workshop on radiative processes; Vancouver, Canada (4 May 1984).

A summary is presented of the remarks the participants made is response to Van Oers' questions about the theory of radiative processes. The author has organized these observations into two general categories. The first is a set of requirements for theory papers (or for theorists). The second is an attempt to list the various necessary ingredients of a modern calculation in order of their increasing complexity.

24650 (FNAL/C—85/54-T) **Searching for quark and lepton compositeness at the SSC.** Albright, C.H.; Bars, I.; Blumenfeld, B.; Braune, K.; Dine, M.; Ferbel, T.; Lubatti, H.J.; Molzon, W.R.; Owens, J.F.; Parke, S.J. (Northern Illinois Univ., Dekalb (USA); University of Southern California, Los Angeles (USA); Johns Hopkins Univ., Baltimore, MD (USA); Stanford Linear Accelerator Center, CA (USA); Institute for Advanced Study, Princeton, NJ (USA); Rochester Univ., NY (USA)). 1984. Contract AC02-76CH03000. 7p. (CONF-8406198—43). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010096.

From Design and utilization of the superconducting super collider summer study; Snowmass, CO, USA (23 Jun 1984).

We examine a variety of issues connected with searching for compositeness at the SSC. These include effects of resolution, alternative methods of looking for deviations from QCD predictions, advantages of polarized beams, and effects of compositeness on photon detection. We also consider how physics may look if the compositeness scale is as low as a few TeV. 17 refs.

24651 (IC—84/36) **Effective gauge theories of composite W, Z and massless fermions.** Craigie, N.S.; Stern, J. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1984. 68p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700529.

We have attempted to identify the circumstances under which a weakly coupled massive gauge theory such as the standard Glashow-Salam-Weinberg model, can emerge as a low energy effective Lagrangian of an ASF preon gauge theory. This involves many issues including the interplay between global and local symmetries and sum rules connecting long and short distance physics. The article puts together these issues and demonstrates that ASF preon models can be very tight and predictive frameworks. We make a systematic search of a minimal extension of the standard electro-weak theory, which could emerge as a low energy effective Lagrangian of an ASF preon gauge theory, in which the left-right symmetry is spontaneously broken by vacuum condensation.

24652 (IC—84/58) **Composite model of electroweak interactions and its manifestation at current collider energies.** Craigie, N.S. (International Centre for Theoretical Physics, Trieste (Italy)). May 1984. 32p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700530.

We present a preon model based on an ASF confining gauge theory, which has as a low energy effective Lagrangian, an electroweak gauge theory very close to the standard model. However, it is predicted that there are some specific and necessary deviations from the Glashow-Salam-Weinberg model. In this preon model, we assume a spontaneous breakdown (or an induced break-

down) of the left-right symmetry, which prevents spin-one composites made up of right-handed fermions propagating well below the composite scale of order 1 TeV. A consequence of this assumption is shown to be the existence of a pion-like scalar, in addition to the Higgs particle of the standard model. Such a particle - it is further claimed - can give rise to single photon events, through a large branching ratio into the channel $\pi \rightarrow Z\,\gamma$ or if lighter than the Z through $Z \rightarrow \pi(\rightarrow \nu\nu\text{-bar}) + \gamma$. The model also predicts a signal very similar to the associated gluino production one of supersymmetric grand unified theories.

24653 (IC—84/60) New selection rules for the SU(5) monopole catalyzed proton decay reactions. Craigie, N.S.; Nahm, W.; Narain, K.S. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700531.

We show that a complete treatment of all the gauge forces experienced by massless s-wave fermions in the SU(5)-monopole system leads to new selection rules, previously overlooked in the bosonization treatment in which only Abelian gauge fields were considered. The most important consequence of these selection rules is that the catalysis reaction requires an anomaly driven process, the pure boundary condition driven process being highly suppressed. At first sight, this means that one cannot ignore the heavy generations, and consequently the reaction is suppressed. We give arguments why this is in fact not the case.

24654 (IC—84/72) Geometrical scaling in high energy hadron collisions. Kundrat, V.; Lokajicek, M.V. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700520.

The concept of geometrical scaling for high energy elastic hadron scattering is analyzed and its basic equations are solved in a consistent way. It is shown that they are applicable to a rather small interval of momentum transfers, e.g. maximally for 't' <or approx.15 GeV^2 for pp scattering at the ISR energies.

24655 (IC—84/75) Matter-antimatter oscillations and proton decay in E_6. Akcay, H. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700532.

We study matter-antimatter oscillations with the hypothesis that the weak isospin conserving mass terms violate C maximally. We find that E_6 with the Higgs system 27-bar+351' does not induce hydrogen-antihydrogen oscillations, neutron-antineutron oscillations and proton decay via higher order Feynman diagrams. In the case that we have an additional Higgs multiplet, like 650, these processes are suppressed by a factor M^{-6} where M is a large mass scale.

24656 (IC—84/85) Cc-bar and bb-bar spectroscopy in the two-step potential model. Kulshreshtha, D.S. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700533.

We investigate the spectroscopy of the charmonium (cc-bar) and bottonium (bb-bar) bound states in a static flavour independent nonrelativistic quark-antiquark (qq-bar) two-step potential model proposed earlier. Our predictions are in good agreement with experimental data and with other theoretical predictions.

24657 (IC—84/89) QCD determination of the A_1-rho-π system through vertex light-cone sum rules. Craigie, N.S.; Paver, N.; Riazuddin. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 27p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700521.

We analyze the rho-A_1-π system within the context of vertex light-cone sum rules, which are believed to be rigorously satisfied in QCD. It is pointed out that these sum rules provide very strong constraints on the hadronic spectrum and with additional assumptions lead to new predictions, which go significantly beyond those obtained from current algebra in the past. In particular, we report some new results about the rho-A_1-π couplings and the various transition form factors in tau-semi-leptonic decays.

24658 (IC—84/102) Hadronic couplings and underlying quark dynamics. Singh, C.P.; Ram, S.N. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700527.

We report certain systematics in the hadronic couplings which we have obtained using S-matrix phenomenology. Their significance regarding the pattern of symmetry breaking in couplings as well as about the underlying quark dynamics is discussed.

24659 (IC—84/112) Mechanism for glueball production. Singh, C.P.; Ram, S.N. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700519.

A production mechanism is suggested to test the production of a glueball resonance in the process $\pi^- p \rightarrow$phiphi n. Our results indicate that gsub(T) resonance in this process corresponds to a quarkonium (ss-bar) state.

24660 (IC—84/145) Neutrino masses and the number of generations. Chhajlany, S.C.; Qadir, A. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700528.

Some cosmological considerations which are relevant for the problem of providing bounds on the number of generations in left-right symmetric GUTs are presented. It is pointed out that there is a constraint on the Dirac mass of the neutrinos and the implications of this constraint are discussed.

24661 (IFUSP-P—371) Some new contributions to neutrinoless double β-decay in an SU(2) x U(1) model. Escobar, C.O.; Pleitez, V. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Nov 1982. 16p. (IFT-P—16/82). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700517.

An SU(2) x U(1) model having both Dirac and Majorana mass terms for the neutrinos, with an extended Higgs sector without natural flavor conservation is considered. Under these conditions, it is shown that for a certain range of the mass parameters of the model, some new contributions become important for the neutrinoless double β-decay $(\beta\beta)o\nu$.

24662 (IFUSP-P—380) Derivation of a pion-rho exchange three-body force and application to the trinucleon system. Robillota, M.R.; Isidro Filho, M.P. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1982. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700522.

The pion-rho exchange three-body force is derived by means of Lagrangians which are approximately invariant under chiral and gauge transformations. The leading contribution to the potential arises from a seagull diagram, which corresponds to forces that are dominantly repulsive and comparable to those due to the exchange of two pions. The qualitative features of the results are analysed by means of plots of the energy of the trinucleon system.

24663 (IFUSP-P—384) X-versus y-scaling in non-relativistic deep inelastic scattering. Santos Padula, S. dos; Escobar, C.O. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Feb 1983. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700534.

It is shown in the context of non-relativistic potential scattering, that the appropriate scaling variable for the deep inelastic region is not the usual Bjorken one, x sub(B) sub(j) = $Q^2/2M\nu$ but instead, the variable $y = 2m\nu\text{-}q\ sup(\rightarrow)^2$. The y-scaling is shown to be obtained in a natural way by using the WKB approximation. Numerical results are presented comparing the approach to scaling in terms of x sub(B) sub(j) and y.

24664 (IFUSP-P—397) Correlation between <P sub(perpendicular) > and the central multiplicity in hydrodynamical model. Hama, Y.; Navarra, F.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). May 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700535.

It is shown that the recently observed growth of <P sub(perpendicular) > when the central multiplicity increases may

be interpreted as a natural consequence of hydrodynamical expansion of highly dense hadronic matter formed during multiparticle production processes.

24665 **(IFUSP-P—415) Do quarks obey general statistics.** Cattani, M.S.D.; Fernandes, N.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jun 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700537.

Assuming that quarks obey general statistics, a non-relativistic approach is proposed that can describe several properties of hadrons : quark confinemnt, baryonic number conservation and 3-quark saturation in baryons. In this formalism, which is different from parastatistics, the assumption of three triplets of quarks is not necessary.

24666 **(IFUSP-P—434) Note on a version of the sigma non-linear model in 3+1 dimensions.** Jasinschi, R.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Oct 1983. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700538.

The model proposed by Cremmer and Scherk to represent the Sigma Non-linear Model in 3+1 dimensions is generalized and one can quantize it via functional path integration method.

24667 **(IFUSP-P—446) Correlation between charged-particle multiplicities and pseudo-rapidity distributions in hydrodynamical cluster model.** Hama, Y.; Navarra, F.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1983. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700539.

It is shown that the correlation between charged-particle multiplicities and pseudo-rapidity distributions, such as the one observed in ISR as well as in recent p sup(-)p collider experiments may well be understood in terms of the previously studied hydrodynamically-expanding large-cluster model.

24668 **(IFVE-OEF—83-124) Weak exchange degeneration and polarization in binary reactions $\pi p p \rightarrow K^0\Lambda$ and $\pi^- p \rightarrow$ Dsup(-)Λsup(+)sub(c).** Arestov, Yu.I.; Chuyko, B.V.; Nurushev, S.V.; Soloviev, L.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700847.

Submitted to the Journal Sov. J. Nucl. Phys.

Hypothesis of weak exchange degeneration of the K*, K** and D*, D** Regge trajectories is proposed to support large absolute values of polarization in p → Λ(Λsub(c)sup(+)) transitions in binary reactions. The hypothesis agrees in general with the amplitude analysis for reaction $\pi^- p \rightarrow K^0\Lambda$ with the strange exchange giving a reasonable starting point for the Λsub(c)sup(+) polarization predictions in reaction $\pi^- p \rightarrow$ Dsup(-)Λsub(c)sup(+).

24669 **(INIS-BR—150) Quantization of spontaneously broken gauge theories in the unitary gauge through the Dirac bracket formalism.** Girotti, H.O.; Rothe, H.J. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). [1985]. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780820.

The quantization of the Higgs model in the unitary gauge using the Dirac bracket quantization procedure is reconsidered. It is found that the structure of some of the equal-time commutators are quite abnormal. It is then shown in a very clear and systematic way that this anomalous structure is closely connected with the well known quartically divergent contribution to the effective Higgs Lagrangian. This contribution has been shown to play an important role in the cancellation of non-renormalizable divergences.

24670 **(INIS-BR—151) Counter example of the Bloch Nordsiek theorem for the quark-gluon scattering.** Doria, R.M. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica; Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). [1985]. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85780836.

Quark-massless quark and quark gluon scattering are studied in the infrared region. In both cases is shown that the infrared divergences do not cancel. This breaks the factorization theorems. The question is raised about how to use the impulse approximation for reactions that contain IR singularities.

24671 **(INIS-mf—9262) Semileptonic decays of the tau lepton and the nonlinear chiral SU(3)XSU(3).** Chahrouri, N. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). 3 Feb 1984. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. File Number DE85780834.

In this thesis the semileptonic decays of the tau lepton are treated in the framework of a nonlinear chiral SU(3) X SU(3). After a description of the experimental situation and the historical development a phenomenological Lagrangian is constructed which is invariant under the nonlinear chiral SU(3) X SU(3). In order to correspond with the real experimental situation the SU(3) X SU(3) symmetry is broken however without breaking of the proved SU(2) X SU(2). The current matrix elements are calculated whereby the effect of the sigma-, Ksup(*)-, and PHI-resonances is included by means of form factors. After the calculation of the phase-space integrals the results are presented and discussed. It is shown that the results of the model reproduce very well the present data. Yet an improvement could be reached by gauging of the theory.

24672 **(INIS-mf—9511) Test of models for soft inclusive hadronic reactions.** Gatignon, L.H.M.H. (Katholieke Univ. Nijmegen (Netherlands)). 7 Dec 1983. 157p. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780835.

Includes Dutch summary.

This thesis describes comparisons of data from soft inclusive K^+ and π-production with various models. The comparisons of the obtained data with models are done on the level of Lorentz-invariant longitudinal momentum distributions. For the aim of these comparisons the author has extracted the π^-, π^+ and Ksup(n) structure functions from the raw bubble chamber measurements. Several parton models are described (quark recombination models and quark fragmentation models). For the so-called valon model, formulae are derived concerning inclusive π and K^+ spectra in the proton fragmentation region, and compared with experimental data. The model is generalized to determine the quark distributions in the kaon. The quark-jet oriented models are further discussed, especially the Lund model.

24673 **(INS—480) Rho-parameter in supersymmetric models.** Lim, C.S.; Inami, T.; Sakai, N. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Oct 1983. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700853.

The electroweak rho-parameter is examined in a general class of supersymmetric models. Formulae are given for one-loop contributions to Δrho from scalar quarks and leptons, gauge-Higgs fermions and an extra doublet of Higgs scalars. Mass differences between members of isodoublet scalar quarks and leptons are constrained to be less than about 200 GeV.

24674 **(INS—481) Masses of the light hadrons in the chiral and cloudy bag models.** Saito, Koichi. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Oct 1983. 38p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700848.

The masses of the light hadrons except for the pion are calculated in the stable chiral and cloudy bag models with the massless or massive u, d quark and pion. Two difficulties in these models, i.e. the lack of stability and the divergence of the quark self-energy, are removed by taking account of a simple non-local quark-pion interaction. The effects of the finite size of the qq-bar pion and the behavior of the quark self-energy are discussed in detail. In our calculation the bag self-energy due to the pion has an important role in the origin of the N-Δ and the Σ-Λ mass differences. The baryon octet and decuplet masses are well reproduced by the present model.

24675 (ITEP—28(1983)) Msub(ν) and L-conservation. Schepkin, M.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700843.

The problem of the neutrino mass and L-conservation is discussed. A short review of some concrete models of neutrino mass generation is considered. Neutrino oscillations and neutrinoless double β decay, $2\beta(o\nu)$, sensitive to neutrino masses and neutrino mixing are described in detail. It is outlined that neutrino oscillations are insensitive to the nature of neutrino mass matrix and can proceed independently from $2\beta(o\nu)$ decay. Neutrino mass measured by tritium β-spectrum must be nonzero if $2\beta(o\nu)$ or/and ν-oscillations (including νsUb(e)) take place.

24676 (JINR—E-2-83-921) Electromagnetic interactions of mesons in the superconductor quark model. Volkov, M.K.; Osipov, A.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700849.

The electromagnetic radii of kaons <rsup(2)>sub(Ksup(+-))=0.34 fm², <rsup(2)>sub(Ksup(0))=-0.06 fm² as well as electric (a) and magnetic (β) polarizabilities of pions and kaons at two possible values of the epsilon meson mass: msub(epsilon)=800 MeV and msub(epsilon)=700 MeV, are calculated in the superconductor quark model. In the first case it is obtained that asub(πsup(+-))=5.9, βsub(psup(+-))=-5.8, asub(πsup(0))=-1.2, βsub(πsup(0))=2.3, asub(Ksup(+-))=1.1, βsub(Ksup(+-))=0.6, asub(Ksup(0))=0.3, βsub(Ksup(0))=0.7. In the second one, asub(πsup(+-))=7.0, βsub(πsup(+-))=-6.9, asub(πsup(0))=-0.041, βsub(πsup(0))=1.1, asub(Ksup(+-))=1.3, βsub(Ksup(+-))=-0.8, asub(Ksup(0))=0.55, βsub(Ksup(0))=0.45. The data are given in units $a(\beta)\times10^{-3}$ fm³ ($e^2/4\pi=1/137$). In evaluating the meson polarizabilities the contributions of the box quark diagrams and e, e(1300), S*, delta, rho, ω, K*, A_1, Q_1 (scalar, vector and axial-vector mesons) pole diagrams are taken into account. The form of intermediate mesons are also used.

24677 (JINR—R-2-84-163) Twist effects and quark-quark correlations in nucleon. On a possibility of experimental investigation by means of JINR-IHEP neutrino detector. Bednyakov, V.A.; Bunyatov, S.A.; Ivanov, Yu.P.; Isaev, P.S.; Kovalenko, S.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1984. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700850.

The contribution of $1/Q^2$ twist correlations to deep inelastic structure functions is investigated in the framework of quantum chromodynamics (QCD). The purpose of this work is to demonstrate the necessity of considering $1/Q^2$ corrections, from one side, for correct experimental verification of QCD predictions, and from the other - for extracting an information about the quark-quark and quark-gluon nucleon correlation functions. The calculations were made in the framework of the Ellis R.K., Furmanski W., Petronzio R. approach, using the soft gluon approximation. From the data analysis the essential contribution of $1/Q^2$ correlation was demonstrated, and also the possibility to separate $\log Q^2$ and $1/Q^2$ scaling violation effects. The necessity to attract low energy data for more precise determination of QCD parameters is clarified. The possibility to investigate $1/Q^2$ corrections, to measure correlation functions, and to determine QCD parameter with approximately 20% precision were substantiated on JINR-IHEP neutrino detector.

24678 (JINR-R—2-83-438) One-loop electroweak corrections to cross sections of νsub(μ)(anti νsub(μ))e scattering processes. Bardin, D.Yu.; Dokuchaeva, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700844.

Submitted to the journal Sov. J. Nucl. Phys. .

An additional study of one-loop electroweak corrections to the differential cross sections of elastic νsub(μ)(anti νsub(μ))e-scattering is carried out in connection with the forthcoming high precision experimental measurement of this cross sections. A new method for computing the contribution of real photons to the radiative correction is suggested. The numerical calculation of corrections has been performed in the situation, typical for a calorimeter type detector.

24679 (JINR-R—2-83-507) Logarithmic and power scaling violation in lepton deep inelastic scattering. Data analysis. Bednyakov, V.A.; Zlatev, I.S.; Ivanov, Yu.P.; Isaev, P.S.; Kovalenko, S.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700845.

Submitted to the journal Sov. J. Nucl. Phys. .

The experimental data of the European Muon Collaboration on deep inelastic μ scattering on hydrogen have been analyzed. The effects of logarithmic and power scaling violation have been investigated in the next-to-leading order [illegible] the allowance for the lowest $1/Q^2$ correction. A strong correlation between experimental value of QCD parameter Λ and absolute value of the power correction have been found. The neglect of corrections of such type is shown to lead to the wrong conclusion concerning Λ value and the experimental status of QCD as a whole. The importance of the thorough investigation of power scaling violation as a source of new information about the nucleon structure have been argumented. Some quantitative characteristics of the first $1/Q^2$ correction to the structure functions have been obtained. Possible ways to overcome the difficulties of separation of the power and logarithmic effects in experimental data of deep inelastic lepton scattering have been discussed.

24680 (JINR-R—2-84-5) Pion photoproduction in a model of composite mesons. Bykovskij, B.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700851.

Low-energy pion-photon interaction is discussed. Effective meson Lagrangians are obtained from four-quark interactions by introducing collective states. The comparison of results for $\pi^0 \to 2\gamma$ and $\gamma \to 3\pi$ processes with low-energy current algebra theorems is made. It is shown that the model reproduces the current algebra results and allows one to take into account meson exchange diagrams. Pion photoproduction in Coulomb field of a nucleus is considered in the framework of this model. Some predictions for pion photoproduction cross section are made for JINR-IHEP experiment, using SIGMA setup.

24681 (JINR-R—2-84-40) Description of composite meson decay in the hamiltonian covariance formulation of field theory. Savrin, V.I.; Sanadze, V.V.; Skachkov, N.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700846.

On the basis of a covariant hamiltonian formulation of quantum field theory the decay of pseudoscalar mesons and $\pi \to \mu\nu$ anti decay are described. The mesons were considered as bound systems of a spinor quark and a antiquark.

24682 (LBL—18690) Axion mass limits from pulsar x rays. Morris, D.E. (Lawrence Berkeley Lab., CA (USA)). Dec 1984. Contract AC03-76SF00098. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010634.

Axions thermally emitted by a neutron star would be converted into x rays in the strong magnetic field surrounding the star. An improvement in the observational upper limit of pulsed x rays from the Vela pulsar (PSR 0833-45) by a factor of 12 would constrain the axion mass M/sub a/ $< 2 \times 10^{-3}$eV if the core is nonsuperfluid and at temperature T/sub c/ $\geq 2 \times 10^8$K. If the core is superfluid throughout, an improvement factor of 240 would be needed to provide the same constraint on the axion mass, while in the absence of superfluidity, an improvement factor of 200 could constrain M/sub a/ $< 6 \times 10^{-4}$eV. A search for modulated hard x rays from PSR 1509-58 or other young pulsars at presently attainable sensitivities may enable the setting of an upper limit for the axion mass. Observation of hard x rays from a very young hot

pulsar with T/sub c/ ≧ 7 x 10^8K could set a firm bound on the axion mass, since neutron superfluidity is not expected above this temperature. The remaining axion mass range 6 x 10^{-4}eV > M/sub a/ > 10^{-8}eV (the cosmological lower bound) can be covered by an improved Sikivie type laboratory cavity detector for relic axions constituting the galactic halo. 48 refs.

24683 (PUC-TN—01/82) Quark model with one-gluon corrections - ground state. Amaral, M.G. do; Zagury, N. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Feb 1982. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700540.

Under the assumption that quarks are confined, in a first approximation, by a relativistic potential U(r) = 1/2(1+β)V(r), several properties of low-lying baryons have been calculated. Corrections to the mass spectrum have also been calculated, by taking the one gluon exchange into consideration.

24684 (PUC-TN—15/82) Dibaryons. Ferreira, E.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Oct 1982. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700523.

The dibaryonic states are an important source of information for the understanding of the strong interactions. The structure of the 6 quark hadrons may reveal properties of these interactions which cannot be investigated in other systems. Our knowledge of the basic nucleon-nucleon interaction and of the nuclear forces in general has changed substantially as a result of the discovery of resonances with baryon number 2. The formation of dibaryons gives important contributions to pion-deuteron processes, and has become an essential ingredient of the description of this three body problem. The same will occur in the study of other systems. The progress of this field, both in experiment and in theory, has been substantial during the last few years. Some aspects of this progress are reviewed here.

24685 (RAL—84-075) Concluding talk. VII Warsaw symposium on elementary particle physics, Kazimierz, May 20-25, 1984. Hong-Mo, C. (Rutherford Appleton Lab., Chilton (UK)). May 1984. 5p. (CONF-8405236—3). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700842.

From 7. symposium on elementary particle physics; Kazimierz, Poland (21 May 1984).

The concluding talk reviews the present state of knowledge of elementary particle physics, based on the research papers presented at the VII Warsaw symposium. Most of the meeting was devoted to testing the standard electroweak theory and QCD, and these topics were discussed in detail. Other research work on hadron-nucleus collisions, solitons, skyrmion, cluster models, diquarks, infrared divergences, jet calculus and quantised string was considered. Experimental facilities for future exploration studies, at DESY, CERN and the U.S. were mentioned.

24686 (RRK—83-12) Extended BRS algebra and color confinement criteria. Shintani, Meiun. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700852.

We examine the color-confinement criteria proposed by Kugo and Ojima. With the use of the extended BRS symmetry and the Nakanishi's theorem, we look for the representations of the BRS algebra compatible with the first condition of their criteria (the K-O condition) and then ask whether or not they are physically acceptable. As a result, the quartet mechanism does not work, and the K-O condition is not regarded as a confinement condition.

24687 (SLAC-PUB—3537) Measurement problem in PROGRAM UNIVERSE. Noyes, H.P.; Gefwert, C. (Stanford Linear Accelerator Center, CA (USA)). Dec 1984. Contract AC03-76SF00515. 21p. (CONF-850683—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008179.

From Symposium on the foundations of modern physics; Joensuu, Finland (16 Jun 1985).

We present a discrete theory that meets the measurement problem in a new way. We generate a growing universe of bit strings, labeled by 2^{137} + 136 strings organized by some representation of the closed, four level, combinatorial hierarchy, of bit-length N_{139} ≧ 139. The rest of the strings for each label, which grow in both length and number, are called addresses. The generating algorithm, called PROGRAM UNIVERSE, starts from a random choice between the two symbols "0" and "1" and grows (a) by discriminating between two randomly chosen strings and adjoining a novel result to the universe, or when the string so generated is not novel, by (b) adjoining a randomly chosen bit at the growing end of each string. We obtain, by appropriate definitions and interpretations, stable "particles" which satisfy the usual relativistic kinematics and quantized angular momentum without being localizable in a continuum space-time. The labeling scheme is congruent with the "standard model" of quarks and leptons with three generations, but for the problem at hand, the implementation of this aspect of the theory is unimportant. What matters most is that (a) these complicated "particles" have the periodicities familiar from relativistic "deBroglie waves" and resolve in a discrete way the "wave-particle dualism" and (b) can be "touched" by our discrete equivalent of "soft photons" in such a way as to follow, macroscopically, the usual Rutherford scattering trajectories with the associated bound states. Thus our theory could provide a discrete description of "measurement" in a way that allows no conceptual barrier between the "micro" and the "macro" worlds, if we are willing to base our physics on counting and exclude the ambiguities associated with the unobservable "continuum". 27 refs.

24688 (UFRJ-IF—01/82) Influence of light-quark masses in dynamical scale breaking. Barcelos Neto, J.; Chanda, R. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700541.

It is demonstrated that light quark masses may significantly contribute to the logarithmic scale breaking in deep inelastic eletromagnetic lepton-nucleon scattering. This is mainly due to the combination of scale variables appearing in structure function equation together with larger 'current' masses for u and d quarks, recently reported in the literature.

24689 (UFRJ-IF—03/82) Upper limits for 'current masses' of light quarks. Barcelos Neto, J.; Chanda, R. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1982. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700542.

A simple way is presented of estimating upper limits of m sub(u) and m sub(d) using positivity properties of the forward eletromagnetic structure function F_2 of the nucleon.

24690 (UFRJ-IF—04/82) Heavy baryons as bound states of three quarks. D'Oliveira, A.B.; Carvalho, H.F. de; Gerck, E. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1982. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700524.

The mass spectrum of heavy baryons as non relativistic bound states of three quarks is calculated, using phenomenological potentials for the quark quark interactions derived from QQ sup(-) effective potentials obtained from fits of the J/psi and UPSILON families. Schroedinger's equation is solved according to Flugge and Zickendraht's prescription, using a method developed specially for confining potentials. Results are compared for several types of confining potentials.

24691 (UFRJ-IF—05/82) Decay of heavy mesons into possible spin 3/2 leptons. Carvalho, H.F. de; Antunes, A.C.B. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1982. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700525.

The recent interest in the study of possible spin 3/2 leptons motivated our calculation of the decay rate of heavy mesons into these leptons. The heavy mesons can be upsilon particles (bb sup(-) systems) or any other system of the qq sup(-) (quark-antiquark) kind with mass larger than those of the upsilon particles, for example, tt sup(-) bound states (not yet detected). The decay rate of these mesons is calculated as a function of the mass of the spin 3/2 leptons. The results obtained are compared with those of the spin 1/2 leptons.

24692 (UFRJ-IF—06/82) Bound systems of heavy quarks. Carvalho, H.F. de; D'Oliveira, A.B. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1982. 22p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700526.

Hadrons are considered as bound states of quarks (mesons = QQ sup(-) and barions = QQQ). An analysis of this model is performed for bound states of heavy quarks, taking into account recent results from perturbative applications of QCD to the bound states of heavy quark - antiquark pairs.

24693 (UWThPh—84-39) Grand unified theories and proton decay. Rupertsberger, H.W. (Vienna Univ. (Austria)). 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700518.

Proton decay in SU-5 is considered.

24694 Constraints on the mixing of a fourth family of quarks. Gronau, M.; Schechter, J. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **31**: No. 7, 1668-1675(1 Apr 1985). Contract AC03-76SF00515;AC02-76ER03533.

This paper studies the constraints on the mixing of a possible fourth family of quarks. A mixing-angle convention is introduced in which s/sub i/jequivalentsinθ/sub i/j represents to a good approximation the ij element of the quark mixing matrix (i<j). A range of parameters is found, $s_{14}<0.06$, $s_{24}<0.1$; $s_{14}s_{24}\sim10^{-4}$—10^{-3} and/or $s_{14}s_{24}>$ or $\approx10^{-2}$, for which the contribution of the fourth family to the K/sub L/-K/sub S/ mass difference is negligible yet may lead to dominant effects in the K^0-K-bar ^{0} CP-impurity parameter ϵ. This may be realized in a scheme in which the four quark generations are mixed mostly in pairs. A possible signature of such a scheme may be an abundant rate of same-sign dileptons at Y(4S) if the fourth up-type quark is sufficiently heavy.

24695 Production of composite neutral Higgs bosons in photoproduction and e^+e^- experiments. Whisnant, K.; Young, B.; Hu, S. (Department of Physics and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] D: Particles and Fields;* **31**: No. 7, 1566-1576(1 Apr 1985). Contract W-7405-ENG-82.

We examine the consequences of a sizable tree-level coupling of a neutral Higgs boson to two photons, which could exist in composite models where the intermediate vector bosons and scalar Higgs bosons are made of the same subconstituents. We find that for certain ranges of the coupling strength and Higgs-boson mass, a neutral composite Higgs boson can be produced and detected in photon-proton scattering and e^+e^- annihilation at currently accessible energies. We also discuss other processes that are not present in the standard model at the tree level, but may lead to observable neutral-Higgs-boson production at, for instance, a p-barp collider.

24696 Valons in mesons. Amiri, F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 and Physics Department, Weber State College, Ogden, Utah 84408). *Physical Review [Section] D: Particles and Fields;* **31**: No. 7, 1561-1565(1 Apr 1985). Contract AC03-76SF00098.

We present a systematic study of the valon distribution functions and valon structure functions for pions and kaons. The implications of our results for low-p/sub T/ inclusive reactions are emphasized. The complications with the structure function of strange valons are discussed and suggestions are made for future experiments to extract it from the structure function of kaons at high Q^2.

24697 High-energy pp and pp-bar forward elastic scattering and total cross sections. Block, M.M.; Cahn, R.N. (Department of Physics, Northwestern University, Evanston, Illinois 60201). *Reviews of Modern Physics;* **57**: No. 2, 563-598(Apr 1985). Contract AC03-76SF00098;AC02-76ER02289.

The present status of elastic pp and pp-bar scattering in the high-energy domain is reviewed, with emphasis on the forward and near-forward regions. The experimental techniques for measuring σ/sub tot/, rho, and B are discussed, emphasizing the importance of the region in which the nuclear and Coulomb scattering interfere. The impact-parameter representation is exploited to give simple didactic demonstrations of important rigorous theorems based on analyticity, and to illuminate the significance of the slope parameter B and the curvature parameter C. Models of elastic scattering are discussed, and a criterion for the onset of "asymptopia" is given. A critique of dispersion relations is presented. Simple analytic functions are used to fit simultaneously the real and imaginary parts of forward scattering amplitudes for both pp and pp-bar, obtained from experimental data for σ/sub tot/ and rho. It is found that a good fit can be obtained using only five parameters (with a cross section rising as $\ln^2 s$), over the energy range $5 < \sqrt{s} < 62$ GeV. The possibilities that (a) the cross section rises only as ln s, (b) the cross section rises only locally as $\ln^2 s$, and eventually goes to a constant value, and (c) the cross-section difference between pp and pp-bar does not vanish as $s\to\infty$ are examined critically. The nuclear slope parameters B are also fitted in a model-independent fashion. Examination of the fits reveals a new regularity of the pp-bar and the pp systems.

24698 phi-meson production as a probe of the quark-gluon plasma. Shor, A. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 and Department of Physics, University of California, Los Angeles, California 90024). *Physical Review Letters;* **54**: No. 11, 1122-1125(18 Mar 1985). Contract AC03-76SF00098;AC03-76SF00515.

The formation of the quark-gluon in relativistic nuclear collisions may be determined by enhanced production of phi mesons. This enhancement would result from the absence of the Okubo-Zweig-Iizuka suppression which inhibits phi production in ordinary p-p and π-p collisions, and from a large abundance of strange quarks in the plasma. The phi will not rescatter significantly in the subsequent expanding hadronic phase and would thereby retain information on the conditions of the hot plasma.

24699 Single-particle momentum distribution at high energies and concept of partition temperature. Chou, T.T.; Yang, C.N.; Yen, E. (Department of Physics, University of Georgia, Athens, Georgia 30602). *Physical Review Letters;* **54**: No. 6, 510-513(11 Feb 1985). Contract FG09-84ER40160.

A concept of partition temperature is introduced in high-energy collisions. It is a natural mathematical consequence of the Darwin-Fowler method, and neither requires nor implies thermal equilibrium. A collision at a given incoming energy is described as an incoherent superposition of collisions with different partition temperatures. Angular distributions are then presented for $\sqrt{s}$ = 540 GeV collisions.

24700 Slopes, coherence and compositeness in high-energy collisions with nuclei. Hendry, A.W.; Lichtenberg, D.B.; Predazzi, E. (Indiana Univ., Bloomington). *Nuovo Cimento;* **77A**: No. 2, 147-164(21 Sep 1983).

The authors examine some recent data on high-energy collisions involving nuclei. All the main features can be readily understood in terms of various degrees of coherence among the constituents.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 24890

24701 (IFUSP-P—388) Phase transition in an Abelian Gauge Theory at finite temperature. Bazeia Filho, D.; Marques, G.C.; Ventura, I. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Mar 1983. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700482.

Within the context of an Abelian Gauge Theory, phase transition driven by the spontaneous generation of domain walls is discused. The critical temperature is calculated semiclassically. The results are very close to those obtained via the effective potential approach.

24702 (IFUSP-P—402) Nonrelativistic exact U(1) symmetric S matrix, and the nonlinear Schroedinger equation. Abdalla, E.; Lima-Santos, A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). May 1983. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700483.

The U(1) symmetric factorizable galilean invariant S matrices are related, to the exact solution of the nonlinear Schroedinger equation, using perturbation theory techniques and to some well known solutions of the Calogero system.

24703 (ITEF—119(1983)) Supersymmetrical models of elementary particles - physics for accelerators of a new family. Vysotskij, M.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 57p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. File Number DE85700813.

A minimum set of particles included in the model based on N=1 supersymmetry is enumerated. Two methods of supersymmetry distortion are considered: 1) explicit soft when asymmetric members are introduced into the Lagrangian and square divergences are compensated in all the orders of the perturbation theory; 2) spontaneous, when supersymmetrical Lagrangian is deprived of supersymmetrical vacuum state. Models in which distortion of global supersymmetry takes place at the expense of supergravity effects are considered. The problem of hierarchy in theories of great unification existence of two scales of masses differing by 13 orders (10^3 GeV and 10^{16} GeV) in parameters of ligneous Lagrangian and absence of their mixing with each other at the expense of radiation correction is discussed.

24704 (LA-UR—85-1060) Physics with low temperature antiprotons. Hynes, M.V. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 9p. (CONF-850152—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009627.

From 3. LEAR workshop; Tignes-Savoie, France (19 Jan 1985).

The advent of the new beam cooling techniques and their application to antiproton production has already made possible major advances in high energy physics. These same techniques offer uniquely exciting possibilities for ultralow energy physics. Through a combination of deceleration stages, antiprotons produced at several GeV (where the production cross section is at a maximum) can be made available for experiments at thermal velocities. High precision measurements of the antiproton mass and magnetic moment can be performed. Comparison of these measurements with those for the proton will test the CPT invariance of internal baryon dynamics at an unprecedented level. In addition the gravitational constant for antimatter can be measured for the first time, and to high accuracy. Each of these measurements will provide very important information on the dynamical symmetry between matter and antimatter in our universe. Antiprotons at thermal velocities will also make these fundamental particles available for experiments in condensed matter and atomic physics. The recent speculation that antiprotons may form metastable states in some forms of normal matter could open many new avenues of basic and applied research.

24705 Chiral fermions from compactification of O(32) and and E(8) x E(8) string theories. Frampton, P.H.; van Dam, H.; Yamamoto, K. (Institute of Field Physics, Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). *Physical Review Letters;* **54**: No. 11, 1114-1117(18 Mar 1985). Contract AS05-79ER10448.

Compactification to four dimensions of a low-energy approximation to ten-dimensional O(32) string theory leads only to grand unification theories with trivial replication of families. The E(8) x E(8) string is more promising and leads in four dimensions to SU(8) with six families. If compactification breaks the symmetry to lower-rank groups, e.g., SU(7) or E(6), there may be any number of families. In the SU(8) and SU(7) models there is nontrivial family symmetry.

24706 Physical CP phase and maximal CP nonconservation. Gronau, M.; Schechter, J. (Group T, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **54**: No. 5, 385-388(4 Feb 1985). Contract AC02-76ER03533.

We give some applications for a CP-nonconserving quantity which is invariant under nontrivial rephasings of the Kobayashi-Maskawa mixing matrix. It is shown to resolve one of the two ambiguities involved in defining the concept of maximal CP nonconservation. The second, more intrinsic, ambiguity is partially resolved in the framework of an especially symmetrical class of parametrizations.

24707 Lepton number violation in softly broken supersymmetry. Pt. 2. Lee, I.H. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Physics). *Nuclear Physics [Section] B;* **246**: No. 1, 120-142(5 Nov 1984).

We study the implications of explicit lepton-number violating soft operators in a general low-energy effective theory with softly broken supersymmetry. Nonzero but relatively small VEVs of scalar neutrinos could exist. In the case where the VEVs of scalar neutrinos vanish, appreciable coefficients of the lepton-number violating soft operators are allowed. We also emphasize the role played by the mixing between the superpartners of the left- and right-handed leptons in the lepton family number violating process $\mu \rightarrow e\gamma$.

6454 Field Theory

REFER ALSO TO CITATION(S) 24480, 24633, 24634, 24639, 24650, 24653, 24655, 24660, 24693, 24696, 24698, 24705, 24860

24708 (CBPF-NF—025/82) Relativistic strings in a non-standard gauge. Galvao, C.A.P.; Negri, L.J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1982. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700470.

Some aspects of the geometric approach to finite open string in a four-dimensional pseudo-Euclidean space-time are analized. The gauge is specified at the end of the process only.

24709 (CERN—84-09, pp 483-501) **Compositeness and the Fermi scale.** Peccei, R.D. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

With 32 refs. .

The positive attitude adopted up to now, due to the non-observation of effects of substructure, is that the compositeness scale Λ must be large: $\Lambda >$ or approx. 1 TeV. Such a large value of Λ gives rise to two theoretical problems which I examine here, namely: 1) What dynamics yields light composite quarks and leptons (msub(f) $<<$ Λ) and 2) What relation does the compositeness scale Λ have with the Fermi scale Λsub(F) = ($\sqrt{2}$ Gsub(F))sup(-1/2) approx.= 250 GeV.

24710 (DOE/ER/45144—1) Research in the theory of condensed matter and elementary particles. [Progress report]. (Chicago Univ., IL (USA)). [1985]. Contract FG02-84ER45144. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010447.

The proposed research is concerned with problems occupying the common ground between quantum field theory and statistical mechanics. The topics under investigation include: superconformal field theory in two dimensions, its relationship to two dimensional critical phenomena and its applications in string theory; the covariant formulation of the superstring theory; formation of large-scale structures and spatial chaos in dynamical systems; fermion-boson mass relations in BCS type theories; and properties of quantum field theories defined over galois fields. 37 refs.

24711 **(IC—84/37) Supersymmetric four-fermion interactions.** Mahdavi, E. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700473.

Supersymmetric generalization of the four-fermion interactions in one spatial and one time dimension is studied. In order to supersymmetrize the four-fermion interaction models, such as Gross-Neveu or Thirring models, it turns out that one needs to introduce a super-current which contains covariant derivative of superfield in its structure, and the Lagrangian constructed from this super-current, therefore, has derivative couplings in the interaction. It is shown that the supersymmetric Gross-Neveu model up to one loop is finite and the ultra-violet overlapping divergences of two loop cancel each other.

24712 **(IC—84/79) S-wave SU(5) monopole-fermion system reduces to a coupled set of exactly solvable QFTs.** Craigie, N.S.; Nahm, W. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700474.

By establishing that the SU(2)-colour sector of fermions in the SU(5) 't Hooft-Polyakov monopole system has an underlying SU(2) Kac-Moody algebra with central charge unity, we show for massless fermions that the whole system can be reduced to a coupled set of exactly integrable two-dimensional QFT's in radial space. Consequently all the non-perturbative effects in the Green functions governing baryon number non-conservation can be explicitly computed up to the effect of the ordinary QCD confining vacuum, which is relevant only at long distances from the monopole's core.

24713 **(IC—84/108) Scaling equations of the coupling constants for the one-dimensional two-fermion model.** Apostol, M.; Barsan, V.; Mantea, C. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1984. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700471.

Jordan's boson representation and cut-off regularization procedure for the one-dimensional two-fermion model is used to get the equivalence with the two-dimensional Coulomb gas and sine-Gordon model. The scaling equations of the coupling constants to third-order are obtained thereby, which slightly differ from those reported in the literature. The scaling of the model onto the exactly soluble models is discussed.

24714 **(IC—84/127) Low-energy β-function in a finite super-Yang-Mills model with multiple mass scales.** Foda, O.; Helayel-Neto, J.A. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700472.

We compute the one-loop contribution to the low-energy light-fermion gauge coupling in a finite supersymmetric gauge theory with two mass scales: a heavy mass that breaks an initial N=4 supersymmetry down to N=2, but respects the finiteness, and a light mass that, for simplicity, is set to zero. We find that the coupling grows with the mass of the heavy intermediate states. Hence the latter do not decouple at low energies, leading to large logarithms that invalidate low-energy perturbation theory. Consequently, further manipulations are required to obtain a meaningful perturbative expansion. Enforcing decoupling through finite renormalizations, that absorb the heavy mass effects into a redefinition of the parameters of the Lagrangian, introduces an arbitrary subtraction mass μ. The requirement that the S-matrix elements be independent of μ leads to a non-trivial renormalization-group equation for the low-energy theory, with a non-vanishing β-function.

24715 **(IFT-M—01/82) Differential formalism aspects of the gauge classical theories.** Stedile, E. (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1982. 119p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE85700475.

The classical aspects of the gauge theories are shown using differential geometry as fundamental tool. Some comments are done about Maxwell Electro-dynamics, classical Yang-Mills and gravitation theories.

24716 **(IFUSP-P—349) Non linear σ model, supergravity and the spinning string.** Abdalla, E.; Jasinschi, R.S. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jul 1982. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700476.

The locally supersymmetric O(N) non linear sigma model and its connection to the spinning string is discussed.

24717 **(IFUSP-P—357) Generalized Langevin equation for the extended charge in stochastic electrodynamics.** Menezes Franca, H. de; Santos, G.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Aug 1982. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700450.

A covariant equation for the motion of the extended charge is derived and it is shown how a consistent description is achieved for nonrelativistic velocities. If the external force is generated by the classical stochastic zero-point electromagnetic field the equation of motion has the form a Langevin equation with memory. The memory function is due to radiation reaction and is related to the charge density which it is assumed to be spherically symmetric and rigid in the nonrelativistic limit. Some deviations from similar attempts are obtained. The extention of the results to finite temperatures is discussed.

24718 **(IFUSP-P—359) Discrete group invariant factorizable S-matrices.** Abdalla, E.; Abdalla, M.C.B.; Santos, A.L. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1982. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700451.

The possibility of obtaining factorizable non trivial S-matrices, invariant under finite symmetry groups is commented.

24719 **(IFUSP-P—386) Vacuum decay in a soluble model.** Camargo Filho, A.F. de; Shellard, R.C.; Marques, G.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Mar 1983. 31p. (IFT-P—12/82). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700478.

A field-theoretical model is studied, where the decay rate of the false vacuum can be computed up to the first quantum corrections in both the high-temperature and zero-temperature limits. It is found that the dependence of the decay rate on the height and width of the potential barrier does not follow the same simple area rule as in the quantum-mechanical case. Furthermore, its behaviour is strongly model-dependent.

24720 **(IFUSP-P—405) Is quark-antiquark annihilation infrared safe at high energy.** Frenkel, J.; Gatheral, J.G.M.; Taylor, J.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1983. 50p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700536.

In perturbative QCD, the Bloch-Nordsieck cross section for quark-antiquark annihilation is known, to order g^4, to be infrared finite, except for terms which are power suppressed at high energies. A fairly simple explanation of this fact, using analyticity, unitarity and an analysis of mass-singularities in both Feynman and axial gauges, is given. The argument applies fairly easily to order g^6. Assuming a generalized unitarity principle, the argument can be extended to all orders.

24721 **(IFUSP-P—430) Some features of Cp sup(n-1) models with fermions.** Abdalla, E.; Lima-Santos, A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700479.

The bound state S-matrix of the Cp sup(n-1) model coupled to fermions in a minimal or supersymmetric way, is presented and the relation to the low energy features in the supersymmetric case is discussed.

24722 **(IFUSP-P—444) Dynamical mass generation for the gravitino in simple N=1 supergravity.** Jasinschi, R.S.; Smith, A.W. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700480.

It is shown that the gravitino mass can be dynamically generated in the simple N=1 supergravity because of the presence of quartic scalar gravitino interaction term.

24723 **(IFVE-OTF—83-117) Classical Yang-Mills field theory with nonstandard.** Alekseev, A.I.; Arbuzov, B.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700804.

Submitted to the journal Theor. Math. Phys. .

Equations of motion, symmetric gauge invariant energy-momentum tensors, conserved currents of the Yang-Mills field with Lagrangians of the form $(DF)^2$, F^3 and their linear combination obtained earlier for description of infrared behaviour of gluon Green functions are obtained in the study. The results of the study can be used for investigating the problems of quantum chromodynamics at long distances, for example the problem on fhe behaviour of quark-antiquark potential.

24724 **(IFVE-OTF—83-146) One-loop calculations in QED in axial gauge.** Boos, E.E.; Kurannoy, S.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700805.

The present paper pursued the aim to test for the simple example of the calculation of the anomalous magnetic moment in quantum electrodynamics, the methods of calculating one-loop integrals in the axial gauge, using the dimensional regularization, and to investigate the independence of the results on the choice of the recipe of how to treat the poles in the denominators $(k\ eta)^{-1}$. It is shown that the techniques developed in another paper, as well as in the present paper, can be successfully applied in such calculations, in spite of the peculiarities of the axial gauge that have been discussed previously. The results of the two different ways of treating singularities $(k\ eta)^{-1}$ (the principal value and 't Hooft's prescription) turn out to be equal. At the same time it was verified that the Green functions obtained by these calculations near the mass shell in the one-loop approximation satisfy the ward identity.

24725 **(INIS-mf—9251) Unbounded representations of symmetry groups in gauge quantum field theory. Pt. 1. Confinement and differentiation.** Voelkel, A.H. (Freie Univ. Berlin (Germany, F.R.). Inst. fuer Mathematik 3). Apr 1983. 74p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780821.

Symmetry groups and especially the covariance (substitution rules) of the basic fields in a gauge quantum field theory of the Wightman-Garding type are investigated. By means of the continuity properties hidden in the substitution rules it is shown that every unbounded form-isometric representation U of a Lie group has a form-skew-symmetric differential deltaU with dense domain in the unphysical Hilbert space. Necessary and sufficient conditions for the existence of the closures of U and deltaU as well as for the isometry of U are derived. It is proved that a class of representations of the transition group enforces a relativistic confinement mechanism, by which some or all basic fields are confined but certain mixed products of them are not.

24726 **(INIS-mf—9261) Covariant representations of massless Fermi fields.** Borek, R. (Goettingen Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 4 Nov 1983. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85780822.

The author shows in the framework of algebraic quantum field theory that representations of the quasi-local algebra of a free, massless spinor field exist which fulfil two axioms of von Neumann. Furthermore, the current algebra of a charged, massless fermion is considered. Finally, representations with the spectral condition of a charged, massless fermion and the quasi-local algebra of a free, massless Majorana particle are constructed.

24727 **(ITEF—136(1983)) To the problem of realization of vector fields on some manifolds.** Petukhov, V.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700792.

Sufficient conditions of realization of the system of usual differential and finite-difference equations on some manifolds are presented. Spheres of different dimensionalities and inversion transformation are studied from this point of view. One method of search for limiting cycles is given in the appendix.

24728 **(ITEP—76(1983)) Supersymmetry transformations of instantons.** Novikov, V.A.; Shifman, M.A.; Vainshtein, A.I.; Voloshin, M.B.; Zakharov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700807.

Instantons in the simplest supersymmetric Yang-Mills theory are considered. Bosonic and fermionic collective coordinates are introduced and it is studied how they change under the supersymmetry transformations. The instanton measure is shown to be explicitly invariant under the transformations. The relation between quantum anomalies and the functional form of the instanton measure are discussed.

24729 **(ITEP—167(1983)) Probability of the false vacuum decay.** Kiselev, V.; Selivanov, K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700806.

The closed expession for the probability of the false vacuum decay in (1+1) dimensions is given. The probability of false vacuum decay is expessed as the product of exponential quasiclassical factor and a functional determinant of the given form. The method for calculation of this determinant is developed and a complete answer for (1+1) dimensions is given.

24730 **(JINR—R-2-83-843) Value of Λ parameter. Model-independent formulation of QCD predictions for deep inelastic scattering.** Ivanov, Yu.P.; Kovalenko, S.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700808.

Submitted to the journal Sov. J. Nucl. Phys. .

The new formulation of QCD predictions for deep inelastic scattering has been given. The main element of the formulation is the transition from usual moments to the so-called "localized moments". It allows to avoid some theoretical uncertainties presented in traditional formulations. Usually one draws the models to remore the ambiguities. The influence of model assumptions have been analyzed for old as well as for new formulations. In the former this influence is noticeable, in the last one-insignificant. The experimental status of QCD and Λ value have been discussed.

24731 **(JINR—R-2-84-97) Lee model in the evolution in coupling constant method.** Belyaev, V.B.; Solovtsova, O.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700811.

With the aim of checking applicability of the ECC-method (evolution in the frame of coupling constant) to the field-theoretical problems solution of the Lee model this method is given. Renormalization of the heavy particle mass and phase shift for the boson by the fermion scattering is obtained.

24732 **(JINR-R—2-84-63) Electrodynamics without gauge conditions.** Azimov, R.I.; Pervushin, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700810.

Submitted to the journal Theor. Math. Phys. .

A scheme of quantization of gauge fields is consistently treated in the framework of the QED. In this scheme the equations of motion with respect to the time component of the field are used instead of gauge conditions. It is shown that in the mechanism of restoration of the relativistic invariance within such a quantum theory the key part belongs to the Schwinger anomalies.

24733 **(JINR-R—2-84-109) Quantum field theory and a new universal high energy scale. Gauge vector fields.** Donkov, A.D.; Ibadov, R.M.; Kadyshevskij, V.G.; Mateev, M.D.; Chizhov, M.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700809.

Submitted to the journal Nucl. Phys. .

The present paper is the second of a new series of publications on quantum field theory with the fundamental mass. Here the theory of the free electromagnetic field and the Yang-Mills field is developed adequately taking into account the noneuclidean character of the momentum 4-space. This scheme allows a specific local formulation in the five-dimensional configuration space. It is remarkable that the symmetry of the theory with respect to gauge transformations within this formulation looks like a broken local gauge symmetry in five dimensions, the breaking mechanism being of an universal form.

24734 **(KMU-HEP—83-10) Test of a Hamiltonian variational method for SU(3) lattice gauge theory in 3+1 dimensions.** Hellmund, M. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). Oct 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700481.

A Hamiltonian variational procedure is discussed for lattice gauge theories, suitable for 3+1 dimensions, based on a trial state vector in terms of link variables. This method has been applied to the calculation of link and plaquette expactation values for the pure SU(3) lattice gauge theory. Agreement with Monte Carlo data is found only in part of the weak coupling cross over region. Taking some 2-link correlations in the trial state vector into account the results are improved in the cross over region and smear out an unwanted phase transition.

24735 **(KMU-HEP—84-01) Quantization by stochastic relaxation processes and supersymmetry.** Kirschner, R. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). Jan 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700484.

We show the supersymmetry mechanism resposible for the quantization by stochastic relaxation processes and for the effective cancellation of the additional time dimension against the two Grassmann dimensions. We give a non-perturbative proof of the validity of this quantization procedure.

24736 **(RRK—83-13) Quantum electrodynamics in a classical approximation, 1.** Kubo, Reijiro. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Sep 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700812.

Quantum electrodynamics is formulated in a classical approximation. A quantum mechanical proper-time is employed as a useful parameter, which enables us to elucidate the relationship between quantum electrodynamics and classical electrodynamics. The classical motion of a charged particle is realized as an asymptotic limit of quantum electrodynamics.

24737 **(RRK—83-15) Classical solutions for the supersymmetric Grassmannian sigma models in two dimensions, 1.** Fujii, K.; Koikawa, T.; Sasaki, R. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Oct 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700814.

The supersymmetric version of the complex Grassmannian sigma models in two euclidean dimensions is studied. By adopting the newly found solutions of the bosonic Grassmannian sigma model as the background fields, we construct explicit fermion classical solutions for the supersymmetric Dirac equations. These fermion solutions are obtained in an elementary way just like their bosonic partners.

24738 **(UFRJ-IF—02/82) Static plane symmetric scalar fields with a traceless energy-momentum tensor in general relativity.** Vaidya, A.N.; Som, M.M. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1982. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700465.

The problem of zero-mass scalar fields coupled to the gravitational field in the static plane symmetric case, is completely solved for a traceless energy-momentum tensor.

24739 **(UFRJ-IF—08/82) Generalized electrovacs.** Vasconcellos, E.P.; Som, M.M. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1982. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700466.

The static solutions of the Einstein-Maxwell equations coupled with the zero rest mass scalar field in a space-time admitting a time-like and two space-like killing vector fields are obtained based on the assumption that the gravitational and electrostatic potentials are functionally related with the scalar potential. The solutions include the plane-symmetric solutions as a particular case. The cylindrically symmetric solutions can be obtained by suitably choosing one of the spatial coordinates as azimuthal coordinate. The transformations are obtained which lead to Taub's coordinate in the case planar symmetry and to Weyl's canonical coordinates in the case of cylindrical symmetry.

24740 **(UFRJ-IF—09/82) Static conformally invariant scalar field.** Accioly, A.J.; Vaidya, A.N.; Som, M.M. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). 1982. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700467.

For a massless conformally invariant scalar field, a class of solutions is obtained to the Einstein equations for which the geometry of the space-time admits one time-like and two space-like Killing vectors. The class of solutions admit plane-symmetric and conformally flat solutions as special cases. The metrics can be interpreted as static cylindrically symmetry solutions if one of the space-like Killing vectors is associated with the rotational motion.

24741 **Nonperturbative effects in quantum field theory on curved spaces.** Patrascioiu, A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 and Physics Department, University of Arizona, Tucson, Arizona 85721). *Physical Review Letters;* **54**: No. 11, 1102-1105(18 Mar 1985).

The quantum continuum action for gauge theories in two dimensions is constructed in the axial gauge. For non-Abelian groups the action differs from the usual expectations by nonperturbative, noncoercive corrections, whose role is to insure gauge invariance for the quantum field theory outside of perturbation theory. Consequently, ordinary perturbation theory and semiclassical approximations become inapplicable. Similar conclusions are expected to apply in more dimensions.

65 PHYSICS. II.

6510 Nuclear Physics

24742 **(CEA-N—2396) Progress report of the Neutron and Nuclear Physics Division for the year 1983.** (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Oct 1984. 190p. (In French). (NEANDC(E)—234-L; INDC(FR)—62/L). NTIS (US Sales Only), PC A09/MF A01. File Number DE85901311.

This progress report gives a presentation of the nuclear physics work carried out in the Service de Physique Neutronique et Nucleaire (C.E. Bruyeres-le-Chatel) during the year 1983. It comprises a part about technical work and equipment and a second part on experiments and their interpretations. The third part is devoted to nuclear data evaluations and processing along with theoretical work. At the end of the report a list is given of the documents issued during the year 1983 and a list of talks given in the laboratory.

24743 **(INIS-mf—9498) [TRIUMF Cyclotron Research Programs, 1982]. Progress report, 1982.** (TRIUMF, Vancouver, British Columbia (Canada)). 1982. 58p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85780858.

The report describes a number of areas of research at the TRIUMPH facility. Substantial progress has been made in the experiment to measure charge symmetry breaking in the n-p system. The investigations on polarized nucleon radiative capture on light nuclei have been ongoing with results of the excitation function for p + d→γ + ^{3}He reaction being published. Studies of the n + p→d + γ reactions are continuing. Results have been obtained in the determination of structure in the three nucleon system by studying the reaction anti d + p using tensor polarized deuterons. The Wolfenstein R-parameter in proton - ^{4}He elastic scattering has been measured at 500 MeV from 15 to 50 degrees (lab.) using the focal plane polarimeter on the MRS. Other experiments involving quasi-elastic scattering of polarized protons at 300 MeV, fission evaporation competition in heavy nuclei and proton-proton bremsstrahlung have been carried out. The status of the Bevelac heavy ion collaboration and the MWPC facility is also included.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 24269, 24770, 24771, 24774

24744 **(DOE/AL/24085—T1) [Absolute fission cross sections in the 14 MeV energy region]. Progress report, July 1982-June 1983.** (New Mexico Univ., Albuquerque (USA)). 1983. Contract AS04-82AL24085. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009918.

Progress is reported on the following studies: thermal neutron absorption cross section of sulfur and the ^{253}Cf nu bar dilemma, the σ (H)/σ (Mn) cross section ratio, the σ (H)/σ (B) cross section ratio, 14 MeV neutron cross section measurements, beryllium-based pulsed neutron detector, and testing charged particle transport and Monte Carlo codes. (WHK)

24745 **(IAE—3585/1) Interference shifts of resonance parameters.** Peregudov, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1982. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700864.

Consideration is given to errors arising in determination of resonance parameters with interferences neglected. The relation between the values of resonance parameters obtained with account of the interference effect and those obtained disregarding it is revealed. The account of interference makes it possible to exclude systematic errors in determination of resonance parameters. In the case of gamma-resonance spectroscopy the account of interference permits also to exclude errors in precise measurements of both chemical shifts of nuclear levels and superfine quadrupole disintegration constants.

24746 (INS-NUMA—44, pp 188-193) **Production of nuclear polarization for short-lived β-radioactive nuclei by means of the tilted foil technique.** Nojiri, Y. (Osaka Univ., Toyonaka (Japan). Dept. of Physics). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

The tilted foil technique developed in the field of the atomic physics has been successfully applied to polarize short-lived β emitter, ^{12}B (I sup(π) = 1$^+$, Tsub(1/2) = 20.4 ms). Together with the experiments on ^{12}B, the principle of the technique and recent results in the atomic physics are reported. A typical example of the application to the nuclear physics is discussed.

24747 (INS-NUMA—44, pp 1-7) **Radii of nuclei off stability. Measurements of total reaction cross sections by incidence of projectile fragments.** Sugimoto, Kenzo (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1982. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

An experiment is proposed to determine systematically the radii of the nuclei produced through the projectile fragmentation process in high energy heavy-ion collision. The measurement of total reaction cross section using the projectile fragments of a single nuclide on a target give information about nuclear radii. The production cross section of the fragments is appreciable for many nuclides. Therefore, it is possible to map systematically the reaction radii of the nuclei which can be produced as the projectile fragments. In an experiment using the projectile fragments as the incident beam, the cross section can be expressed as a function of the radii of a projectile and a target. An experiment with He-8 produced by the fragmentation of C-12 is proposed. The He-8 has four neutrons in the p-3/2 orbit outside the He-4 core. Proton and neutron distributions for He isotopes were calculated on the basis of the Hartree-Fock method. The information related to this kind of distribution can be obtained by the proposed experiment. The nuclear structure effect is seen in the nuclear radii of other unstable nuclei. The experimental examples of the isotope shift measurement and the excitation energy are presented.

24748 **(UUIP—1090) Versatile Moessbauer analysis program.** Jernberg, P.; Sundqvist, T. (Uppsala Univ. (Sweden). Inst. of Physics). Jun 1983. 99p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85700871.

MDA - Moessbauer Data Analysis, is a user oriented computer program, aiming to simulate a Moessbauer transmission spectrum, given by a set of parameters, and compare it with experimental data. The calculation considers a number of experimental situations and the comparisons can be made by least squares sums or by plotting the simulated and the measured spectrum. A fitting routine, minimizing the least squares sum, can be used to find the parameters characterizing the measured spectrum.

24749 **(UUIP—1103) Treatment of saturation effects in Moessbauer spectroscopy and the evaluation of spectra.** Jernberg, P. (Uppsala Univ. (Sweden). Inst. of Physics). Feb 1984. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700872.

Two different methods for solving the Transmission Integral (TI), encountered in e.g. Moessbauer spectroscopy are presented. In the first one the TI is approximated by a single channel calculation, while taking care of the nearby absorption cross section, contributing to the absorption, by comparing the cross section at the energy of the actual channel with the appropriate solution in the thin absorber approximation (TAA). The method is compared with the results of TAA and of a simple single channel approximation. The second method is more elaborate, aiming to be as exact as possible although not too time-consuming. The inner part of the TI is convoluted numerically whereas the outer part is calculated analytically by an asymptotic approximation.

6512 Nuclear Properties And Reactions, A=1-5

REFER ALSO TO CITATION(S) 24751

24750 **(DOE/ER/05223—69) Intermediate-energy nuclear theory. Final report, July 1, 1976-August 31, 1984.** Bryan, R.A. (Texas A and M Univ., College Station (USA). Dept. of Physics). Feb 1985. Contract AS05-76ER05223. 25p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010440.

We summarize the research accomplishments of the Texas A and M Medium-Energy Theory Group which was funded by the Department of Energy from July 1976 through August 1984. Our research was mainly in the area of nucleon-nucleon and NNπ theory and data analysis, although some effort was also devoted to the elementary-particle aspects of these hadrons in order to better understand the NN force. Publications and reports are listed.

24751 (INIS-mf—9269) Observable off-shell effects and the Pauli principle in the reactions ^{4}He+deuteron → ^{4}He+deuteron and ^{4}He+deuteron → ^{4}He+neutron+proto n. Hahn, K. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Physik). 21 Jun 1983. 122p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780839.

In the present thesis we have studied the system ^{4}He-neutron-proton. Starting from the microscopic three-cluster model of the resonating group method the Hamiltonian of the optical fishbone model is defined for the three cluster centers which contains effects from the Pauli principle of the whole six-nucleon system. Beside this microscopically founded Hamiltonian a second, purely phenomenologically defined Hamiltonian is applied, which is only fixed by the phase shifts of the systems neutron-proton and ^{4}He-nucleon. Both Hamiltonians are phase equivalent in the subsystems, i.e. the scattering waves of the subsystems differ only in the near-range. A comparison of the three-particle scattering observables of both approaches at the incident energies Esub(d)sup(lab) = 7.5 and 12 MeV shows surprisingly strong off-shell effects in the system ^{4}He-neutron-proton, the order of magnitude of which exceeds both in the elastic and in the breakup case widely the experimental measurement uncertainty. It means that in our system the near-range of the subsystem scattering waves and by this the kind of the reduction of the six-nucleon problem to a three-body problem play an important role. Furthermore we can in the case of the elastic reaction ^{4}He + deuteron -> ^{4}He + deuteron, for the differential cross sections and the spherical analyzing powers in angular ranges, where the neglected Coulomb interaction should have only little influence, prove, that the microscopically founded Hamiltonian leads to results which are more realistic than in the case of the phenomenological model.

24752 ^{3}Hearrow(p,p)^{3}He analyzing powers between 25 and 35 MeV. McCamis, R.H.; Verheijen, P.J.T.; van Oers, W.T.H.; Drakopoulos, P.; Lapointe, C.; Maughan, G.R.; Okumusoglu, N.T.; Brown, R.E. (Department of Physics, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 5, 1651-1655(May 1985).

A polarized ^{3}He target, which uses conventional optical pumping with ^{4}He discharge lamps, has been used for the measurement of ^{3}He analyzing powers A/sub y/(θ) at energies of 25.0, 30.0, 32.5, and 35.0 MeV. The statistical uncertainties in the data are on the order of 0.03; the systematic uncertainty is estimated to be 0.05. These data are compared with fits and predictions from various phase shift analyses.

6513 Nuclear Properties And Reactions, A=6-19

REFER ALSO TO CITATION(S) 24537, 24755

24753 (ANL/NDM—90) Fast-neutron-spectrum measurements for the thick-target ^{9}Be(d,n)^{10}B reaction at E/sub d/ = 7 MeV. Smith, D.L.; Meadows, J.W.; Guenther, P.T. (Argonne National Lab., IL (USA)). Apr 1985. Contract W-31-109-ENG-38. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85010481.

Spectra of neutrons with energies ≧ 800 keV which are emitted from a metallic beryllium target that is thick enough to completely stop 7-MeV incident deuterons are measured using organic scintillators and the pulse-beam time-of-flight method. Data are acquired for twenty different emission angles in the laboratory over the range 0 to 155 degrees. The resulting information on the energy-angle detail of neutron emission is then employed in calculations which are performed in order to examine certain effects of the anisotropic neutron production on typical measurements of integral fast-neutron reaction cross sections. 28 refs.

24754 (INS—478) Coupled-reaction-channel approach for molecular orbital phenomena of valence nucleons in heavy ion collisions. The ^{12}C + ^{13}C system. Oertzen, W. von; Imanishi, B. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Sep 1983. 97p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85700869.

A complete coupled-reaction-channel method is applied to molecular orbital phenomena of the valence nucleon in the scattering of ^{12}C on ^{13}C, i.e., in elastic and inelastic transitions to the single particle states of ^{13}C*(gr.1/2$^-$; 3.086MeV,1/2$^+$; 3.854MeV,5/2$^+$) with the consideration of ^{12}C- core exchange process. The system is analyzed with respect to the occurence of higher order transitions of the direct (inelastic) and transfer (core-exchange) processes of the valence nucleon in ^{13}C. It is found that in the state of positive total parity the transfer and direct processes act additively and lead to extreme higher order steps of the multi-interactions, if the ground state (1p1/2) and the excited states (2s1/2 and 1d5/2) are taken into account. Transitions between the excited subchannels show strong coupling effects, which are due to the reorientations of the d5/2 orbitals. The reoriented system couples to the ground channel (l-parity mixing) so favourably that the multi-interaction series hardly converges. The consequence of these observations are discussed in terms of the formation of molecular nucleon orbitals based on the polarization and the hybridization of the original orbitals.

24755 (INS-NUMA—44, pp 184-187) Time component of main axial vector current. Matsuta, K. (Osaka Univ., Toyonaka (Japan). Dept. of Physics). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

Published in summary form only.

24756 (LA—10338-T) Measurement of pion double charge exchange on carbon-13, carbon-14, magnesium-26, and iron-56. Seidl, P.A. (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE85010355.

Cross sections for the /sup 13,14/C,^{26}Mg,^{56}Fe(π^+,π^-)/sup 13,14/O,^{26}Si,^{56}Ni reactions were measured with the Energetic Pion Channel and Spectrometer at the Clinton P. Anderson Meson Physics Facility for 120 ≦ T/sub π/ ≦ 292 MeV and 0 ≦ θ ≦ 50. The double isobaric analog states (DIAS) are of primary interest. In addition, cross sections for transitions to ^{14}O(0$^+$, 5.92 MeV), ^{14}O(2$^+$, 7.77 MeV), ^{56}Ni(gs), ^{13}O(gs), and ^{13}O(4.21 MeV) are presented. The ^{13}O(4.21 MeV) state is postulated to have J/sup π/ = 1/2$^-$. The data are compared to previously measured double-charge-exchange cross sections on other nuclei, and the systematics of double charge exchange on T ≧ 1 target nuclei leading to the DIAS are studied. Near the Δ_{33} resonance, cross sections for the DIAS transitions are in disagreement with calculations in which the reaction is treated as sequential charge exchange through the free pion-nucleon amplitude, while for T/sub π/ > 200 MeV the anomalous features of the 164 MeV data are not apparent. This is evidence for significant higher order contributions to the double-charge-exchange amplitude near the reasonable energy. Two theoretical approaches that include two nucleon processes are applied to the DIAS data. 64 references.

24757 Numerical simulation of medium energy heavy ion reactions. Aichelin, J.; Bertsch, G. (University of Tennessee, Knoxville, Tennessee 37996 and Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 5, 1730-1738(May 1985).

Reactions between heavy ions at medium energy are calculated using the Boltzmann-Uehling-Uhlenbeck equation. This equation incorporates the effects of a mean field as well as Pauli blocking of the nucleon-nucleon collisions. The numerical solution for two light systems, ^{16}O+ ^{12}C at 25back20A MeV bombarding energy and ^{12}C+ ^{12}C at 84back20A MeV bombarding energy, is presented and discussed in detail. In the absence of nucleon-nucleon collisions, the theory reduces to classical mean-field physics and agrees well with the quantal time-dependent Hartree-Fock theory. With collisions, the system is driven toward equilibrium even at the lower bombarding energy. The final state nucleon distribution is compared to single-particle spectra and is found to agree quite well in shape.

24758 Gamow-Teller matrix elements from the $^{11}B(p,n)^{11}C$ reaction at E/sub p/roughly-equal26 MeV. Grimes, S.M.; Anderson, J.D.; Davis, J.C.; Howell, R.H.; Wong, C.; Carpenter, A.W.; Carr, J.A.; Petrovich, F. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 5, 1679-1690(May 1985).

New data are presented for the $^{11}B(p,n)^{11}C$ reaction taken at 1 MeV intervals for proton bombarding energies in the E/sub p/ = 16—26 MeV range. In the experiment, final states in ^{11}C up to E/sub x/≈10 MeV were clearly identified and differential cross sections were extracted for the first four levels in ^{11}C. The E/sub p/ = 26 MeV data are examined in microscopic distorted-wave approximation calculations using the wave functions of Cohen and Kurath to describe the states in ^{11}B and ^{11}C and using the G matrix interaction of Bertsch et al. for the effective nucleon-nucleon interaction. Gamow-Teller matrix elements for transitions to excited states in ^{11}C are extracted on the basis of these calculations, thus extending the information on Gamow-Teller matrix elements in the mass 11 systems beyond the ground state matrix element known from β decay. Throughout, the results are contrasted with existing information from electromagnetic studies of ^{11}B. It is concluded that the Cohen-Kurath model places too much Gamow-Teller strength in the low lying states of the mass 11 systems and not enough strength at higher excitation energies. In addition, this model underestimates the net contribution to M1 matrix elements from the isoscalar spin and current and isovector current parts of the M1 operator.

24759 Double analog transition $^{14}C(\pi^+,\pi^-)$ ^{14}O at 50 MeV. Leitch, M.J.; Piasetzky, E.; Baer, H.W.; Bowman, J.D.; Burman, R.L.; Dropesky, B.J.; Gram, P.A.M.; Iron, F.; Roberts, D.; Rebka, G.A. Jr. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **54**: No. 14, 1482-1485(8 Apr 1985).

Differential cross sections for the double-isobaric-analog-state transition in the reaction $^{14}C(\pi^+,\pi^-)$ ^{14}O were measured over the angular range 20° to 130°. The cross section extrapolated to 0° is 3.9 +- 0.5 μb/sr and the angle-integrated cross section is 15.3 +- 1.6 μb. These values are much larger than expected from the trends of data at higher energies and may indicate the presence of new phenomena. The results are compared to recent six-quark bag-model calculations which predict such trends.

24760 Mean-field calculations of fluctuations in nuclear collisions. Marston, J.B.; Koonin, S.E. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 and W.K. Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* **54**: No. 11, 1139-1141(18 Mar 1985). Contract AC05-84OR21400.

We apply the new variational principle of Balian and Veneroni to calculate the fluctuations in final-fragment mass, charge, and kinetic energy for the systems $^{16}O+$ ^{16}O (E/sub lab/ = 160 MeV) and $^{40}Ca+$ ^{40}Ca (E/sub lab/ = 278 MeV). The calculated fluctuations are larger than conventional time-dependent-Hartree-Fock results and, in the latter case, are consistent with the experimental fragment mass distribution.

24761 Thermodynamic interpretation of multiparticle emission in relativistic heavy-ion collisions. Gleeson, A.M.; Raha, S. (Univ. of Texas, Austin). *Lettere al Nuovo Cimento della Societa Italiana di Fisica;* **38**: No. 18, 599-605(31 Dec 1983).

The authors analyze the scattering of the heavy-ion Ne off NaF at relativistic energy. They study the spectra of the emission fragments for evidence of a thermodynamic-hydrodynamic collective motion. Using fixed bean and target, they are able to fit the spectra of the pion, deuteron and proton emission. The fit is consistent with an interpretation of an expanding hot fluid of interacting nucleons.

24762 Simple isospin relations for transitions in A = 13. Peterson, R.J. (Univ. of Colorado, Boulder). *Physica Scripta;* **T5**: 190-192(1983).

The isospin symmetry breaking noted in pion inelastic scattering on ^{13}C has been shown previously to be consistent with helium-ion scattering and charge exchange data. Here, proton scattering and charge exchange data at a beam energy of 26.1 MeV are shown to exhibit rather different features. Since the great isospin asymmetries are found for stretched-spin states very near the proper nucleon decay thresholds, it is suggested that external mixing is responsible for the consistent observations for strongly absorbed projectiles, but that nucleon beams are sensitive to different radial locations and so the proton-induced data may not be related simply to more surface-dominated data. 26 references, 1 figure, 2 tables.

24763 Fusion reactions between heavy nuclei. Birkelund, J.R.; Huizenga, J.R. (Univ. of Rochester, NY). *Annual Review of Nuclear and Particle Sciences;* **33**: 265-322(1983). Contract AC02-76ER03496.

Experimental data and several models for fusion reactions between heavy nuclei are reviewed. The review concentrates on models of the fusion process that have been used to explain the macroscopic features of fusion excitation functions at energies above the fusion reaction threshold.

6514 Nuclear Properties And Reactions, A=20-38

REFER ALSO TO CITATION(S) 24763

24764 Energy dependence of the cross sections for the $^{24}Mg(^{16}O,^{13}C)^{28}Si$(g.s.) reaction. Sanders, S.J.; Ernst, H.; Henning, W.; Jachcinski, C.; Kovar, D.G.; Schiffer, J.P.; Barrette, J. (A.W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511 and Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 5, 1775-1782(May 1985).

Excitation functions have been measured at 0° and 180° for the $^{24}Mg(^{16}O,^{13}C)^{28}Si$(g.s.) reaction, and at 180° for the $^{24}Mg(^{16}O,^{12}C)^{28}Si(2^+)$ reaction over the energy range 36 MeV< or = E/sub c.m./< or = 54 MeV. Angular distributions were measured at E/sub c.m./ = 35.5 and 36.2 MeV where, for the latter energy, much of the angular range between 0° and 180° was covered. These data, combined with earlier measurements at lower energies, establish that the reaction cross section is strongly influenced by resonances of the compound system over a large energy range. At the higher energies, however, both the energy averaged cross section and the resonance amplitudes fall off sharply. An attempt is made to reproduce the observed structure in the ^{28}Si(g.s.) 0° and 180° excitation functions by fitting to the data a band of Breit-Wigner resonances with an energy dependence proportional to J(J + 1). The general behavior of the 0° and 180° yield is well reproduced by this procedure, even though there are twice as many resonance poles as there are clear bumps in the data. Some regularity is evident in the resulting resonance parameters, although the fitted resonance amplitudes show greater scatter than expected for a nuclear molecular band.

24765 Elastic magnetic electron scattering from ^{29}Si and ^{31}P. Miessen, H.; Rothhaas, H.; Luehrs, G. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernphysik); Peterson, G.A.; Hicks, R.S.; Lindgren, R.A. (Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy); Berman, B.L. (Lawrence Livermore National Lab., CA (USA)); Kowalski, S.; Williamson, C.F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics; Massachusetts Inst. of Tech., Cambridge (USA). Bates Linear Accelerator Center). *Nuclear Physics [Section] A;* **430**: No. 1, 189-213(19 Nov 1984).

Elastic magnetic electron-scattering form factors from ^{29}Si and ^{31}P have been measured in the range of momentum transfer from 1.0 to 2.8 fm^{-1}. Analysis of the data using a particle-core-coupling model yields 2ssub(1/2) occupation probabilities for the valence nculeon of 0.46 +- 0.01 for the neutron in ^{29}Si and 0.48 +- 0.01 for the proton in ^{31}P. The radius of the 2ssub(1/2) proton orbit in ^{31}P has been found to be (5.3 (+2.6 -1.5))% larger than the corresponding neutron orbit in ^{29}Si. Recent large-basis shell-model cal-

culations of the form factors do not accurately reproduce the experimental results.

6515 Nuclear Properties And Reactions, A=39-58

REFER ALSO TO CITATION(S) 24760, 24763

24766 **(INIS-BR—157) Cross section determination of threshold like (n,p), (n,α) and (n,2n) reactions with 14 MeV neutrons for the ^{50}Ti, ^{68}Zn and ^{90}Zr nuclides.** Barreira Filho, J.L. (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). Sep 1982. 103p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780841.

Activation cross-sections at (14,4 + - 0,3) MeV neutron energy have been measured by means of conventional and cyclic activation techniques, utilizing an intense sealed tube neutron generator of cylindrical ion-acceleration structure (KORONA). The reactions investigated and the corresponding cross-sections (in mb) are: ^{50}Ti(n,p) ^{50}Sc(14,3 + - 2,1); ^{68}Zn(n,p) sup(68g) Cu (5,0 + - 1); ^{68}Zn(n,p) sup(68m) Cu (3,6 + - 0,6); ^{68}Zn (n,α) ^{65}Ni (10,3 + - 1,8); ^{90}Zr (n,p) sup(90m) Y (9,8 +m - 1,7); ^{90}Zr (n,α) sup(87m) Sr (3,2 + - 0,5); ^{90}Zr (n,2n) sup(89m)Zr (75 + - 12). The neutron flux and the mean energy of the neutrons from the KORONA were also determined through the monitor reactions ^{27}Al (n,A)^{24}Na, ^{90}Zr(n,2n)^{89}Zr and ^{93}Nb(n,2n) sup(92m) Nb. For comparison with the experimentally obtained results, the hitherto known cross-section data from the literature were carefully compiled, too, in this work. In the case of the ^{68}Zn(n,p) sup(68g) Cu reaction, a special formulation was developed to calculate its cross-section, taking into consideration the most important fact that all the excited levels of ^{68}Zn arising from the β^- decay of sup(68g) Cu are also fed by the β^- activity decay of sup(68m) Cu and by the isomeric transitions and internal conversions of this metastable state.

24767 **Improved limits on the double beta decay half-lives of ^{50}Cr, ^{64}Zn, ^{92}Mo, and ^{96}Ru.** Norman, E.B. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 5, 1937-1940(May 1985).

Searches have been made for the β^+/electron-capture-type double decays of ^{50}Cr, ^{64}Zn, ^{92}Mo, and ^{96}Ru and for the double β^+ decay of ^{96}Ru. The sought-for signature of such decays was the emission of coincident back-to-back 511-keV annihilation gamma rays from the sample under study. No positive evidence of any of these decays was observed. However, from these experiments, improved lower limits on the half-lives of these nuclei against such decays have been established.

6516 Nuclear Properties And Reactions, A=59-89

REFER ALSO TO CITATION(S) 24763, 24793

24768 **(INIS-mf—9268) Neutron and gamma emission in the fusion reaction ^{86}Kr + ^{76}Ge at 3,8 MeV/u.** Dittmar, H. (Frankfurt Univ. (Germany, F.R.). Fachbereich Physik). 13 Apr 1983. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE85780840.

In the present thesis the neutron and gamma emission of Compound nuclei with high excitation energy and large maximal angular momenta was studied, which are formed in fusion reactions with heavy ions. Thereby the system ^{86}Kr + ^{76}Ge was studied at a beam energy of 3.8 MeV/u, because here intermediate mass product nuclei arise for which the neutron emission is the dominant particle channel. For the neutron detection a detector arrangement was developed, which consisted of several NE213 liquid scintillators constructed in the Institute for Nuclear Physics. A separation of neutrons and gamma quanta is possible by pulse shape discrimination. For the determination of energy and angular distribution of the emitted neutrons 8 of these detectors were put under angles from 0° to 105° in distances between 30 and 50 cm from the target. A further NE 213 detector of larger volume was put at -90° in 6 cm distance from the target and applied for the detection of neutrons and gamma quanta in coincidence. By this preferently events with high neutron respectively gamma multiplicity corresponding to low and high angular momentum ranges of the compound nucleus can be filtered out. For monitoring purposes the energy spectrum of the gamma quanta was registrated by a Ge(Li) detector under 135°. Additionally by three Ge(Li) detectors at 0°, 90°, and 135° the angular distribution of discrete gamma lines was registrated. Here also the additional NE213 detector at -90° served as multiplicity filter.

24769 **(INS-NUMA—44, pp 26-28) UNISOR experiments, 5.** Noma, Hiroshi (Hiroshima Univ. (Japan)). Nov 1982. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

Published in summary form only.

24770 (INS-NUMA—44, pp 29-44) **Experimental study of short-lived nuclei far from stability by Tohoku ISOL.** Shinozuka, T. (Tohoku Univ., Sendai (Japan). Cyclotron and Radioisotope Center). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

An EMIS facility has begun operation at one of the beam lines of a multipurpose cyclotron of K = 50 MeV. The separator is of a Scandinavian type of 55° deflection and 1500 mm dispersion. During developments of the target-ion sources and tape transport system, the on-line test experiments have been performed, and several short-lived nucleis of Zn, Cu, Se and K were identified. The outline of ISOL experimental system and the results of decay of Tsub(z) = - 1/2 nuclide ^{69}Zn are reported, and the fsub(t)- value, the Gamow-Teller matrix element and the mass of ^{69}Zn are discussed. The future plan of the development of target-ion source system and the ISOL experiment are also described.

24771 **(ITEF—189(1983)) Possibility of the neutrinoless double beta decay observation in the ^{76}Ge→^{76}Se isobaric transition.** Kirpichnikov, Z.V.; Starostin, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700875.

Multicrystalline Ge(Li) detector made of enriched germanium in combination with NaI(Tl) active shielding is proposed to be used for observation of binary neutrinoless β-decay in ^{76}Ge. It is expected to achieve the lower limit of a half-life period (Tsub(1/2) approximately equal to 4x10^{25} years) in the experiment.

24772 **High-spin state spectroscopy of /sup 88,90/Zr.** Warburton, E.K.; Olness, J.W.; Lister, C.J.; Zurmuehle, R.W.; Becker, J.A. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **31**: No. 4, 1184-1210(Apr 1985).

The high-spin states of ^{88}Zr and ^{90}Zr were studied up to ~12-MeV excitation via the /sup 74,76/Ge(^{18}O,4nγ)890Zr fusion evaporation reactions. Decay schemes were constructed on the basis of gamma-ray excitation functions, angular distribution and linear polarization measurements, γ-γ coincidences, and level lifetimes determined from both Doppler shift attenuation and recoil distance measurements. An effort was made to make as definite spin-parity assignments as possible and to delineate the reliability of these assignments. Probable spins up to ~20h were formed in both nuclei. The experimental results are compared to preliminary results of a large-scale shell model calculation. The yrast spectra of both nuclei can be interpreted as arising from intrinsic modes of excitation with no evidence for collective behavior.

6517 Nuclear Properties And Reactions, A=90-149

REFER ALSO TO CITATION(S) 24773, 24793, 24807

24773 (FEI—1425) Contribution of 'gsub(9/2)sup(-1)gsub(9/2) > configuration in the direct reaction ^{90}Zr(p,n). Titarenko, N.N.; Yadrovskij, E.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700548.

In the framework of the microscopic method of distorted waves (first Born approximation) the contribution of (gsub(9/2)sup(-1)(n)gsub(9/2)(P):Jsup(π) > states, where Jsup(π) = $0^+/^+$... 9^+, into the neutron rigid group of the integral spectrum of the ^{90}Zr(p, n)^{90}Nb reaction, where E=22.2 MeV, is estimated. The analysis of the observe differential cross sections of IAS 0^+ excitation (E=5.15 MeV), 1^+(2.126 MeV) and 2^+(0.854 MeV) is performed.

24774 (INS-NUMA—44, pp 138-143) Measurements on the delayed neutron emission probability by a β- and γ-ray spectroscopic technique. Okano, K.; Funakoshi, Y.; Kawase, Y. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

An on-line isotope separator of helium-jet type has been constructed for the study of neutron rich nuclei produced by thermal neutron fission. Several nuclear spectroscopic works on neutron rich Rb and Cs nuclei are now being performed by this separator. A measurement on the delayed neutron emission probability has been performed by a new method of measurements, utilizing the β- and γ-ray spectroscopic technique. The value of Pn for ^{94}Rb has been determined as 10.1 +- 1.0%.

24775 (INS-NUMA—44, pp 160-164) Excited states in the doubly magic nucleus $_{50}{}^{132}$Sn$_{82}$. Kawade, K. (Nagoya Univ. (Japan). Faculty of Engineering). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

The half lives of the levels at 4714 keV and 4415 keV in ^{132}Sn have been determined to (20.2 +- 0.8) ns and (4.0 +- 0.3) ns, respectively. The transition probabilities from both half lives agree well with the theoretical predictions and, thereby, provide information on the structure of the positive parity states in ^{132}Sn. New excited states have been identified from $\gamma\gamma$ coincidence measurements. Strong beta feeding to a state at 7210 keV was established. This level is interpreted as a 6^- state formed after a πgsub(9/2)$^{-1}$ $\rightarrow$ νgsub(7/2)$^{-1}$ GT β^- transition from the 7^- ground state of ^{132}In. The deexcitation of the 7210 keV state passes through a 4351 keV state, providing support for a 3^- assignment of this level.

24776 (INS-NUMA—44, pp 165-171) Experiment at Los Alamos. Isomer yield with spallation reaction. Shibata, Seiichi (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

In the measurement of spallation yields from the interaction between high energy protons and ^{92}Mo, ^{96}Mo, ^{100}Mo and ^{130}Te, a new prospect has appeared when isomer yield ratios are compared. The two pairs of isomers which we have measured are ^{86}Ysup(m,g) and ^{87}Ysup(m,g). The total independent yields of these two products behave just as expected for different target systems. However, the ground state (low spin) independent yields of both ^{86}Y and ^{87}Y in ^{130}Te target system were very low. The meta-stable states accounted for almost 100% of the nuclide yields in distinct contrast to the shallower spallation results. We also have additional isomer yield ratios, but incompletely analysed.

6518 Nuclear Properties And Reactions, A=150-189

REFER ALSO TO CITATION(S) 24622

24777 (INS-NUMA—44, pp 144-149) Level structures in Yb nuclei far from stable nuclei. Hashizume, Akira (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

Applying n-γ, γ-γ coincidence techniques, the excited levels in ^{158}Yb and in ^{157}Yb nuclei were studied. Stress is placed ona neutron detection technique to assign (HI,xn) reactions which produce the nuclei far from β stability line.

24778 (JINR—R-4-84-151) Correlations of quasi particles in the deformed nuclei ground states. Bastrukov, S.I.; Nesterenko, V.O. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700866.

The effect of ground state correlation on the properties of the one-phonon states in deformed nuclei is considered. The isoscalar and isovector multipole forces are taken into account. The calculations with fixed energies of first one-phonon states show that the ground state correlation leads to small increase of collectivity of these states. The isovector force inclusion decreases the role of correlations. On the whole, the effect of ground state correlations is small even for strongly collective states.

24779 Band termination at very high spin in ^{158}Yb. Ragnarsson, I.; Bengtsson, T.; Nazarewicz, W.; Dudek, J.; Leander, G.A. (Department of Mathematical Physics, Lund Institute of Technology, Box 725, S-220 07 Lund, Sweden). *Physical Review Letters;* **54**: No. 10, 982-985(11 Mar 1985). Contract AC05-76OR00033;AC05-84OR21400.

The unusual yrast spectrum of ^{158}Yb at very high spins is interpreted in terms of a band termination at I/sup π/ = 36^+. A similar spectrum with band terminations is obtained in microscopic cranking calculations for this nucleus. A basic element of the theory is that the finiteness of rotational bands is connected with a gradual shape change until the rotation takes place around a symmetry axis.

24780 Quasivibrational bands at high spins in ^{158}Yb. Baktash, C.; Schutz, Y.; Lee, I.Y.; McGowan, F.K.; Johnson, N.R.; Halbert, M.L.; Hensley, D.C.; Fewell, M.P.; Courtney, L.; Larabee, A.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **54**: No. 10, 978-981(11 Mar 1985). Contract AC05-84OR21400;AC02-76CH00016;AS05-76ER04936.

High-spin states in the transitional nucleus ^{158}Yb were populated via several (HI,4n) reactions. Two yrast bands were established up to I/sup π/ = (40^+) and (31^-). In contrast to the negative-parity band up to I = 31 and the positive-parity states up to I = 24 which show collective rotational patterns, states with I/sup π/ = 26^+—36^+ exhibit a nearly vibrational excitation mode. Such a quasivibrational pattern suggests a gradual transition toward oblate shapes and is the first evidence for a "band termination" in a heavy nucleus.

24781 Properties of nuclei at high spins. Stephens, F.S. (Lawrence Berkeley Lab., CA). *Physica Scripta;* **T5**: 5-9(1983). Contract AC03-76SF00098.

Nuclei generate high spins by two methods, alignment of single-particle angular momentum and collective rotation. The competition of these two modes is discussed for the highest spins 40 $\sim<$ I $\sim<$ 65h. Evidence is presented that alignment of the h/sub 9/2/ and i/sub 13/2/ proton orbitals from the next-higher major shell produces large affects at high spins in rotational nuclei in the A = 160-166 region. It is suggested that such major shell effects

produce the still larger irregularities known to occur in the lighter nuclei of this region. 10 references, 5 figures.

6519 Nuclear Properties And Reactions, A=190-219

24782 (INS-NUMA—44, pp 20-25) **Unstable nucleus production after $\pi\mu$-capture.** Nagamine, K. (Tokyo Univ. (Japan). Faculty of Science). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

Mechanisms of residual nucleus formation after pion and muon capture are summarized, where a particular attention was paid for the processes of isomer production, many nucleon emission, neutronless capture, etc. New results on the isomer production after pion capture are presented whose experiments are performed at UT-MSL pulsed meson facility.

24783 (INS-NUMA—44, pp 71-75) **Alpha-decay in heavy nuclei.** Gono, Y. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

The α-decays from the short-lived excited states in the N=128 isotones were studied using the in-beam spectroscopic techniques. The reduced α-decay width γsub(α)sup(2) were obtained for those which deexcite the isomeric states in these nuclei. The unusually large γsub(α)sup(2) was found for the 10.590 MeV α-decay in ^{217}Ac. The effect of the nuclear deformation on the α-decay is briefly discussed.

24784 **Dispersion relation and the low-energy behavior of the heavy-ion optical potential.** Nagarajan, M.A.; Mahaux, C.C.; Satchler, G.R. (Science and Engineering Research Council, Daresbury Laboratory, Daresbury, Warrington WA4 4AD, United Kingdom). *Physical Review Letters;* **54**: No. 11, 1136-1138(18 Mar 1985). Contract AC05-84OR21400.

A dispersion relation is used to show that the "anomalous" behavior of the real part of the optical potential for ^{16}O+ ^{208}Pb scattering at low energies is an example of a general property of heavy-ion optical potentials at energies approaching the top of the Coulomb barrier, where the flux into nonelastic channels is drastically reduced.

24785 **Properties of the ^{208}Po(0$^+$,T = 22) double isobaric analog state.** Morris, C.L.; Greene, S.J.; Gilman, R.; Fortune, H.T.; Zumbro, J.D.; Faucett, J.A.; Burleson, G.R.; Dhuga, K.S.; Seidl, P.A.; Mordechai, S. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **54**: No. 8, 775-776(25 Feb 1985).

Pion double charge exchange has been used to populate the double isobaric analog state (DIAS) in ^{208}Po with use of the doubly magic target ^{208}Pb. The DIAS was found at an excitation energy of 32.46 +- 0.17 MeV with a width of 0.85 +- 0.40 MeV. The excitation energy of the DIAS can be used along with the energy of the isobaric analog state to determine separately the linear and the quadratic terms of the isobaric multiplet mass equation. The resulting linear and quadratic terms are b = -31.6 +- 3.7 MeV and c = 0.33 +- 0.09 MeV, respectively.

6520 Nuclear Properties And Reactions, A=220 And Above

REFER ALSO TO CITATION(S) 24059, 24744, 24801

24786 **(INIS-mf—9265) Study of the electromagnetic properties of vibrational bands in ^{230}Th, ^{232}Th, ^{236}U, and ^{238}U by means of Coulomb excitation.** Gerl, J. (Frankfurt Univ. (Germany, F.R.). Fachbereich Physik). 4 Jul 1983. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE85780842.

In the present thesis Coulomb excitation experiments with S ions on the isotopes ^{230}Th, ^{232}Th, ^{236}U, and ^{238}U are described. The measurements were performed at the Munich MP Tandem Accelerator at an incident energy of 135 MeV. The focal point of the studies lied in the study of the electromagnetic properties of vibrational bands of the actinide nuclei. The largest angular momenta reached extended for the ground state band to I=14(h/2π) for the K=0$^-$ octupole band I=11(h/2π), for the β band I=10(h/2π), and for the γ band I=8(h/2π). Furthermore, single states of the K=1$^-$ and the K=2$^-$ octupole band could be detected. For several transitions in the ground state band it was possible to determine the disorientation of the angular distribution of the decay γ radiation. The E2 matrix elements, which were determined for the ground state band transitions, agree with the indications of the rigid rotor model. From the measured branching ratios of the named vibrational bands in the framework of a formalism indicated by Bohr and Mottelson rotational-vibrational coupling matrix elements for ^{232}Th were calculated. For the nuclei ^{230}Th and ^{232}Th the coupling strength between β band and γ band could be determined. E2/M1 mixing ratios, which were determinable for some interband transitions from the γ band, have for increasing angular momentum a decreasing slope. The E2 matrix elements between γ band and ground state band were derived from the measured γ intensities.

24787 **(INIS-mf—9278) In-beam study of the rotational states in actinides after alpha-induced nuclear reactions.** Hardt, K. (Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 27 Jun 1983. 79p. (In German). NTIS (US Sales Only), PC A05/MF A01. File Number DE85780843.

In the experiments described in this thesis the ground state rotational bands of a whole series of actinide isotopes has been studied by means of α-induced nuclear reactions. The rotational bands studied in the even isotopes could be identified up to a spin of about 16 (h/2π). With this data it was now possible to establish a broad systematic of the rotational energies up to relatively high angular momenta. Also in the odd isotopes ^{233}U and ^{239}Pu it was possible to follow the ground state rotational bands up to higher spins and to compare them with predictions of the rotational model. By means of the (α,α'2n) reaction the nuclei ^{230}Th and especially ^{228}Th could by populated.

24788 **(INS-NUMA—44) Reports of workshop on nuclei far from stability.** (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Nov 1982. 199p. (In Japanese). (CONF-8205297—). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870.

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

Abstracts of individual items from the workshop were prepared separately for the data base. (GHT)

24789 **(JINR-R—7-83-667) Measurement of recoil range of heavy actinides produced in multinucleon transfer reactions induced by ^{22}Ne ions.** Demin, A.G.; Druin, V.A.; Lobanov, Yu.V.; Sagajdak, R.N.; Utenkov, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700876.

Submitted to the journal Sov. J. Atomic Energy.

The recoil ranges of ^{256}Md and ^{253}Fm produced by the ^{249}Bk+^{22}Ne (118 MeV) reaction and of ^{246}Cf, ^{242}Cm and ^{240}Cm produced by the ^{239}Pu^{22}Ne (121 MeV) reaction have been measured. It is shown that the recoil ranges of these multinucleon transfer reaction products in the direction of the beam exceed those of complete fusion reaction products by a factor of 2. It enables one to effectively separate the products of different exit channels, the separation factor being from several units to 10^3. This fact may be used in experiments to synthesize and identify transfermium elements in complete fusion reactions.

24790 (PNCT-N—831-82-01, pp 96-100) **Determination of plutonium-241 half-life by mass spectrometric measurement.** Hiyama, Takashi; Wada, Yukio; Onishi, Koichi (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Sep 1982. NTIS (US Sales Only), PC A09/MF A01. File Number DE85780801.

In Annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. April 1981-March 1982.

Much data for Pu-241 half-life have been reported, but these values range from 13.8 years to 15.1 years depending on investigators. In order to define the half-life of Pu-241, the half-life was calculated by analyzing the mass spectrometry data obtained in the author's laboratory over the past six years on Plutonium Isotopic Standard Reference Materials prepared at the National Bureau of Standards (NBS). The sample used for this work consisted of SRM-947 and SRM-948 prepared at NBS. Before mass spectrometric analysis, the plutonium aliquot was separated from its Am-241 daughter by anion exchange chromatography, since Am-241 is not distinguished from Pu-241 in the mass spectrometer. $^{241}Pu/^{239}Pu$ and $^{241}Pu/^{240}Pu$ ratios were calculated from the values of mass spectrometric measurement. From the relation of log N to time, the half-life of Pu-241 was determined, based on the slope using a least squares fit. The half-life of Pu-241 was estimated to be 14.29+-0.15 years.

24791 **Excitation functions for production of heavy actinides from interactions of ^{40}Ca and ^{48}Ca ions with ^{248}Cm.** Hoffman, D.C.; Fowler, M.M.; Daniels, W.R.; von Gunten, H.R.; Lee, D.; Moody, K.J.; Gregorich, K.; Welch, R.; Seaborg, G.T.; Bruechle, W. (Isotope and Nuclear Chemistry Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 5, 1763-1769(May 1985).

Excitation functions have been measured for production of isotopes of Bk through Fm in bombardments of ^{248}Cm with 234- to 294-MeV ^{40}Ca ions and with 239- to 318-MeV ^{48}Ca ions. The maxima of the isotopic distributions for these elements occur at only 2 to 3 mass numbers larger for ^{48}Ca than for ^{40}Ca reactions. The shapes of the distributions and the half-widths of about 2.5 mass numbers are quite similar to those observed previously for reactions of ^{16}O, ^{18}O, ^{20}Ne, and ^{22}Ne with ^{248}Cm. In general, the excitation functions for ^{40}Ca show maxima near the Coulomb barrier while those for ^{48}Ca are about 20 MeV above the barrier. The cross sections decrease rather slowly with increasing projectile energy over the energy range studied, indicating that the additional projectile energy is not manifested as excitation energy of these actinide products.

24792 **Spontaneous fission of rutherfordium isotopes.** Somerville, L.P.; Nurmia, M.J.; Nitschke, J.M.; Ghiorso, A.; Hulet, E.K.; Lougheed, R.W. (University of California, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **31**: No. 5, 1801-1815(May 1985).

We have found several new spontaneous fission (SF) activities and suggested assignments for some of them to rutherfordium (element 104) isotopes. Their half-lives and production cross sections have been measured by collecting recoils on a moving nickel or steel tape and transporting them past stationary mica track detectors at known velocities. The following tentative assignments are based on several cross bombardments and comparisons between experimental and calculated production cross sections: ^{256}Rf(9 +- 2 ms), ^{257}Rf(3.8 +- 0.8 s, 14 +- 9% SF), ^{258}Rf(13 +- 3 ms), ^{259}Rf(3.4 +- 1.7 s, 9 +- 3% SF), ^{260}Rf(21 +- 1 ms), and ^{261}Rf(47 +- 5 ms). Presently we are unable to assign several other new spontaneous fission activities with half-lives of ~15 ms, ~22 ms, ~100 ms (Z<104), ~1.6 s, ~5 s, ~5 s, ~30 s, and ~47 s. Contrary to other observations, we have not found any indication for an 80-ms spontaneous fission activity, earlier credited to the spontaneous fission decay of ^{260}Rf, in reactions in which we expected to produce this isotope. Our measurements support a shift in the spontaneous fission half-life systematics at element 104, first proposed by Flerov and Oganessian et al. and later predicted by Randrup et al. and Baran et al. and attributed to the disappearance of the second hump of the double-humped fission barrier and a weakening of the 152-neutron subshell.

24793 **Analysis of octupole instability in medium-mass and heavy nuclei.** Nazarewicz, W.; Olanders, P.; Ragnarsson, I. (Lund Inst. of Tech. (Sweden). Dept. of Mathematical Physics); Dudek, J. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires; Niels Bohr Inst., Copenhagen (Denmark)); Leander, G.A. (UNISOR, Oak Ridge, TN (USA)); Moeller, P. (Lawrence Berkeley Lab., CA (USA)); Ruchowska, E. (Rijksuniversiteit Groningen (Netherlands). Kernfysisch Versneller Inst.; Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej). *Nuclear Physics* [*Section*] *A;* **429**: No. 2, 269-295(5 Nov 1984).

Strutinsky-type potential-energy calculations are performed using various models for the microscopic as well as macroscopic energy terms. The following conclusions are nearly model-independent: Ra-Th nuclei around Aapprox.=225 have ground-state equilibrium shapes with both quadrupole and octupole deformation; nuclei in the heavy barium region are just barely unstable with respect to octupole distortion of the quadrupole shape, while lighter nuclei are stable with respect to octupole deformation, albeit softness occurs e.g. in the region of the very light and the very heavy Zapprox.=34 isotopes. Tables of ground-state equilibrium shapes, calculated with the Woods-Saxon potential, are presented for doubly-even nuclei in the Ba and Ra-Th regions of octupole-deformed nuclei.

6530 Nuclear Theory

24794 **(ANL-PHY—83-1) Delta-nucleus dynamics: proceedings of symposium.** Lee, T.S.H.; Geesaman, D.F.; Schiffer, J.P. (eds.). (Argonne National Lab., IL (USA); Chicago Univ., IL (USA)). Oct 1983. Contract W-31-109-ENG-38. 596p. (CONF-830588—). NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE84003655.

From Delta-Nucleus dynamics symposium; Argonne, IL, USA (2 May 1983).

The appreciation of the role in nuclear physics of the first excited state of the nucleon, the delta Δ(1232), has grown rapidly in the past decade. The delta resonance dominates nuclear reactions induced by intermediate energy pions, nucleons, and electromagnetic probes. It is also the most important non-nucleonic degree of freedom needed to resolve many fundamental problems encountered in the study of low-energy nuclear phenomena. Clearly, a new phase of nuclear physics has emerged and conventional thinking must be extended to account for this new dimension of nuclear dynamics. The most challenging problem we are facing is how a unified theory can be developed to describe Δ-nucleus dynamics at all energies. In exploring this new direction, it is important to have direct discussions among researchers with different viewpoints. Separate entries were prepared for the 49 papers presented. (WHK)

24795 **(FEI—1456) Program VAR-82: calculation of nuclear reaction cross sections in the framework of the distorted wave method. 3. Rearragement reaction. One-nucleon transfer.** Titarenko, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700868.

Algorithms and universal program of computerized calculation of integral and differential cross sections of particle scattering (with 0, 1/2, and 1 spins) on nuclei are described in the framework of the first Boron approximation of the distorted wave method. Physical assumptions and mathematical models being in the basis of the direct particle reconstruction process are under discussion. Derivation of main formulae of the reaction with a finite radius of fragment interaction is presented, and zero radius approximation is regarded as a particular case of the formulae obtained. A possibility of their consideration in the framework of the effects of finite interaction radius is also considered. Reactions of one-nucleon transmissions are considered in detail and some recommendations on effective usage of the program for the description of reconstruction reaction are given. Analysis of the data obtained and results of numerous investigations of deuteron (d, p) direct stripping reactions allow one to make the following conclusions. Absolute magnitudes of differential cross sections and their structure are dependent essentially on a magnitude of orbital momentum (l) of the exciting

state. A form of angular distributions of escaped protons may be changed noticeably in the region of diffraction minimums and at large angles as a function of potential parameters.

24796 **(FEI—1458) Analysis of experimental data on nuclear momentum of inertia, obtained from angular distributions of nuclear reaction products.** Lovchikova, G.N.; Maksyutenko, B.P.; Simakov, S.P.; Trufanov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700862.

The multiparameter dependence of nuclear moments of inertia is analysed. Their dependence on nucleon composition, parity and other characteristics is considered. The distribution of moments of inertia is described as parabolic depending on binding energy of these nuclei. The parabola width is the same for all elements. Minima of these parabolas corresponding to minimum values of moments of inertia at the given Z, belong to one of the stable isotopes of this element. The energy range between the minima of these distributions per charge unit is the same for all elements. The distribution of minimum values of moments of inertia by Z is described by the parabolas of equal width from light to heavy nuclei.

24797 **(INS—482) Measurements of pd quasi-elastic scattering in 800 MeV pA collision, and momentum spread of pn system inside nucleus.** Tanihata, Isao. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Oct 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700874.

Coincidence spectra of pd Quasi-Elastic Scatterings (QES) in 800 Mev proton-nucleus (pA) collisions have been measured. From the proton spectrum, the momentum spread of the pn system ("d") inside the nucleus has been determined. The momentum spread of "d" (σ sub("d")) obtained by pd QES are compared with the spread obtained by the projectile fragmentation. It is shown that the σ sub("d") is much smaller at large momentum transfer region than the spread at small momentum transfer region. From a mass dependence of the ratio of the pd to pp QES cross sections, the mean free path of deuteron has been determined to be 1.7 +- 0.3 fm. The absolute value of the pd QES cross section has been reproduced by the model which is based on plane-wave impulse approximation plus attenuation due to the rescattering of the particles. The mass dependence of the cross sections was also well fitted by the model.

24798 (INS-NUMA—44, pp 57-70) **Unstable nuclei from the viewpoint of atomic mass formula.** Uno, Masahiro (Waseda Univ., Tokyo (Japan). School of Science and Engineering). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

The significance of the study on nuclei far from stability is briefly surveyed, and problems arising in the prediction of masses for such nuclei are pointed out. Based upon these, two types of atomic mass formulas with empirical shell terms are proposed, and the outline of a new statistical method to be applied to the determination of the adjustable parameters in them is given. This method enables us to construct mass formulas which give not only mass values but also their theoretical errors. Part of the results is shown, and the resulting two mass formulas are compared with the recent mass data as well as other current mass formulas.

24799 (INS-NUMA—44, pp 172-179) **Renormalization of the nucleon weak currents in nuclear dynamics.** Minamisono, Tadanori (Osaka Univ., Toyonaka (Japan). Dept. of Physics). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

Possible experiments were discussed to study the renormalization of the coupling constants of the nucleon weak currents in the nuclear dynamics as well as the meson exchange effects in the time component of the main axial currents. Determination of the effective vector coupling constants g' sub(βv) is also proposed for mirror β-decays.

24800 (INS-NUMA—44, pp 180-183) **Polarization phenomena in projectile fragmentation.** Tanaka, K.H. (Osaka Univ., Toyonaka (Japan). Faculty of Science). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

Published in summary form only.

24801 (INS-NUMA—44, pp 82-90) **Criticism on attempts to synthesize super heavy elements.** Lee, S.M. (Tsukuba Univ., Sakura, Ibaraki (Japan)). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

A criticism is presented on attempts to synthesize superheavy elements by heavy-ion reactions. In particular a detailed discussion is made on the fusion reactions tried to produce superheavy elements so far. It is emphasised that our present knowledge is rather poor to predict a law of competition between fusion-fission and fusion-evaporation. An existance of upper limited angular momentum J sub(ER), at which the evaporation is dominant, is suggested. Furthermore it is shown that a future experimental and theoretical study of J sub(ER) will be essential to predict the cross section for synthesizing superheavy elements quantitatively.

24802 (INS-NUMA—44, pp 150-154) **IBM predictions for the level structure of nuclei far from stability.** Otsuka, Takaharu (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Nov 1982. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. File Number DE85780870. (CONF-8205297—).

From Workshop on nuclei far from stability; Tanashi, Tokyo, Japan (31 May 1982).

The Inetracting Boson Model - 2 (IBM-2) has been applied to a wide variety of nuclei covering from vibrational to rotational. There are four essential parameters in the IBM-2 phenomenology. The systematics of these parameters as functions of the neutron and the proton numbers has been clarified considerably well. Thus, it became possible to make predictions based on the systematics. Such predictions are mainly for nuclei far from stability. The Xe-Ba-Ce region is taken as an example. There are IBM-2 predictions for exciation energies, B(E2)'s, etc. The $B(E2;0_1^+ \rightarrow 2_1^+)$ calculated as a function of the neutron number shows a distinct peak at the middle of the N = 50 - 82 shell. This B(E2) value has not been measured around the predicted peak. If the position of the peak is found at a different position, the guiding principle of the IBM-2 phenomenology should be modified in the relation to the particle-hole transformation.

24803 **(ITEF—124(1983)) Deep inelastic nuclear reactions.** Gavrilov, V.B.; Leksin, G.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 30p. (In Russian). (CONF-8310360—1). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700870.

From Conference on problem of many bodies in nuclear physics; Leningrad, USSR (4 Oct 1983).

Deep inelastic nuclear reactions under hadron effect are discussed. The problem of separating contributions of quasifree and deep inelastic processes to the cross section is considered. The strong A-dependence of cross-sections of cumulative particle production in deep inelastic reactions is noted. When studying A-dependence the isotopic effect was revealed: proton (neutron) yields of heavy nucleus isotopes don't change if the neutron (proton) number in target nucleus changes. It is concluded that deep inelastic nuclear reactions represent the result of incident particle interaction with several nucleons in intimate group inside the nucleus. Nucleons in this group combine into one quark bag.

24804 **(JINR—E-4-84-27) Low-lying dipole states in spherical nuclei.** Dao Tien Khoa; Ponomarev, V.Yu.; Voronov, V.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700865.

Submitted to the journal Bull. Acad. Sci. USSR, Phys. Sci.

The low-lying dipole states observed in elastic photon scattering from some spherical nuclei have been investigated within the quasiparticle-phonon model. The explanation is given for a specific dependence of B(E1) values on the neutron number for these nuclei. It has been shown that the low-lying 1^- states can be interpreted as two-phonon $2_1^+ \times 3_1^+$ excitations. The E1 transitions from these states to the ground states clearly indicate a principal difference between the random phase approximation and Tamm-Dancoff approximation.

24805 **(JINR—R-2-84-114) Investigation of properties of pion excitations in nuclear matter for different effective $\pi\pi$-interactions.** Bunatyan, G.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1984. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700867.

In the nuclear matter near to the pion field instability for various effective $\pi\pi$-interactions the pion polarization operator, excitation density, entropy and heat capacity are calculated. The approximation for Green function at T not equal to 0 of the pion field near its instability are used for calculations. It follows from the obtained results that $\pi\pi$-interaction essentially effects the pion polarization operator, excitation density and the thermodynamical properties at T not equal to 0, changing their dependence on temperature and density of nuclear matter.

24806 **(KEK—83-6) Proceedings of the workshop on hyper nuclear physics.** Yukawa, T. (ed.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jun 1983. 111p. (In Japanese and English). (CONF-8211201—). NTIS (US Sales Only), PC A06/MF A01. File Number DE85700863.

From Workshop on hyper nuclear physics; Oho, Ibaraki, Japan (25 Nov 1982).

A workshop on hyper nuclear physics was held on November 25-27, 1982, at the National Laboratory for High Energy Physics of Japan (KEK). The proton synchroton at KEK will be devoted for the hyper nuclear physics in the near future, and the prospective experimental projects in this field were discussed at the workshop. The problems discussed were the production of hyper nuclei, the structure of hyper nuclei, hyperon interaction, and the decay of hyperon. For this study, high quality K-beam is required. The proceedings include the reports on the Kaon beam line, an experimental proposal on the hyper nuclear spectroscopy, discussion on hyper nuclear spectroscopy, the structure of light p-shell lambda hypernuclei, the experiment on hyper nuclear reaction, the magnetic moment of hyper nuclei, search for strange dibaryons, polarized targets with a cryogenic system, a spectrometer for hyper nuclear spectroscopy, YN and YY interactions, lambda-N soft core potential and hypertriton, lambda-sigma conversion and Pauli principle, the sigma-hyper nuclear states in finite nuclei, the microscopic three-body cluster of hyper nuclei, and K^--nucleus elastic scattering.

24807 **(LA—10248-MS) PRECO-D2: program for calculating preequilibrium and direct reaction double differential cross sections.** Kalbach, C. (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85010323.

The code PRECO-D2 uses the exciton model for preequilibrium nuclear reactions to describe the emission of particles with mass numbers of 1 to 4 from an equilibrating composite nucleus. A distinction is made between open and closed configurations in this system and between the multi-step direct (MSD) and multi-step compound (MSC) components of the preequilibrium cross section. Additional MSD components are calculated semi-empirically to account for direct nucleon transfer reactions and direct knockout processes involving cluster degrees of freedom. Evaporation from the equilibrated composite nucleus is included in the full MSC cross section. Output of energy differential and double differential cross sections is provided for the first particle emitted from the composite system. Multiple particle emission is not considered. This report describes the reaction models used in writing PRECO-D2 and explains the organization and utilization of the code. 21 refs.

24808 **(LBL—19114) Pion production and the nuclear equation of state.** Harris, J.W.; Odyniec, G.; Pugh, H.G.; Schroeder, L.S.; Tincknell, M.L.; Bock, R.; Brockmann, R.; Sandoval, A.; Stock, R.; Stroebele, H. (Lawrence Berkeley Lab., CA (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Heidelberg Univ. (Germany, F.R.). Inst. fuer Hochenergiephysik; Marburg Univ. (Germany, F.R.). Fachbereich Physik; Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Fisica; Texas A and M Univ., College Station (USA). Cyclotron Inst.). Oct 1984. Contract AC03-76SF00098. 22p. (CONF-8410210—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009941.

From 7. high energy heavy ion study conference; Darmstadt, F.R. Germany (8 Oct 1984).

There has been considerable recent interest in the nuclear equation of state and how it may be determined in relativistic nucleus-nucleus collisions. In these collisions extremely high temperatures are reached and compression to densities several times that of normal nuclear matter are predicted. This affords us the unique opportunity to study, in a somewhat controlled manner, the behavior of nuclear matter under these extreme conditions. If the observables that are measured in experiments can be related in a quantitative way to state variables of the system then the equation of state can be extracted. This relation plays a very important role in understanding the formation and collapse of supernovae and the stability and structure of neutron stars. Furthermore, it can be used to test and constrain field theoretical approaches to nuclear matter and to help to better understand the dynamics of high energy nucleus-nucleus collisions. In this presentation the relationship between the nuclear equation of state and relativistic nucleus-nucleus collisions will be discussed with an emphasis on how to extract the former. That a high density state of the collision should exist will be shown. One observable, namely the pion multiplicity, will be shown to survive the succeeding stages of the collision process to provide information on the equation of state at high densities. The resulting equation of state will be presented and discussed in the light of recent theoretical development. 34 refs., 12 figs.

24809 **Quantization of asymmetric shapes in nuclei.** Engel, J.; Iachello, F. (A. W. Wright Nuclear Structure Laboratory, Yale University, New Haven, Connecticut 06511). *Physical Review Letters;* **54**: No. 11, 1126-1128(18 Mar 1985). Contract AC02-76ER03074.

We propose a description of asymmetric shapes in nuclei in terms of a bosonic U(16) group, and discuss some properties of rotation-vibration spectra in the SU(3) limit of the model.

24810 **Vector polarization in reactions with spin-1 particles.** Conzett, H.E.; Goldstein, G.R.; Moravcsik, M.J. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **54**: No. 6, vp(11 Feb 1985).

It is shown that in scattering involving a spin-1 particle, complete determination of the amplitudes can be made from measurements of the final-state tensor-polarization components alone.(AIP)

24811 **Nuclear pairing and dynamical breakdown of Isospin symmetry.** Scadron, M.D. (Department of Physics, University of Arizona, Tucson, Arizona 85721). *Annals of Physics (New York);* **159**: No. 1, 184-198(Jan 1985). Contract AC02-80ER10663.

Viewed from the perspective of dynamical breakdown of isospin symmetry, the scale and nucleon number A dependence of the valence pairing energy gap Δ are approximately predicted from the nuclear Debye energy. A Goldberger-Treiman type of relation is also obtained for nuclear pairing in analogy with QCD along with correlated bosons resembling a pion and sigma meson. Finally a critical temperature is discussed such that the BCS relation $\Delta/k/$

sub B/T/sub c/ ~1.8 holds for nuclear pairing as well as for superconductivity.

24812 **One effect of using relativistic kinematics in the analysis of heavy-ion elastic scattering.** El-Azab Farid, M.; Satchler, G.R. (Oak Ridge National Lab., TN (USA)). *Physics Letters, [Section] B;* **146**: No. 6, 389-391(25 Oct 1984).

The ion-ion potential deduced from an optical model analysis of heavy-ion elastic scattering may be sensitive to whether the transformation from laboratory to centre-of-mass system used is relativistic or not. For illustration, a semiclassical description is used to give a simple estimate of this effect and its dependence on energy and the masses of the nuclei. For example, the change in potential strength is larger than 20% for ^{40}Ar scattering from ^{208}Pb at an energy as low as 44 MeV per nucleon.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 23808, 23823, 23833

24813 **(BNL—36077) Magnetic scattering and polarized neutrons.** Shirane, G.; Majkrzak, C.F. (Brookhaven National Lab., Upton, NY (USA)). Jan 1985. Contract AC02-76CH00016. 15p. (CONF-850110—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009823.

From International conference on neutron scattering in the '90s; Juelich, F.R. Germany (14 Jan 1985).

The last few years have witnessed considerable progress in the use of polarized neutron beam techniques for the study of condensed matter physics. Among the methods actively pursued at present are neutron spin echo as pioneered by Mezei for ultra high resolution and the energy integrated magnetic scattering measurement technique developed by Brown and Ziebeck. We have concentrated on a medium resolution range utilizing 5 to 100 MeV polarized neutrons. In this review we discuss recent work at Brookhaven on the development of the triple axis neutron scattering technique with polarization analysis. We have now reached the stage where quantitative characterization, in absolute units, can be done for a wide range of energy and momentum transfers in paramagnetic scattering. We will discuss some examples of recent inelastic measurements on 3d ferromagnets as well as diffraction studies of multibilayer thin film structures.

24814 **(FEI—1366) Interaction of slow neutrons with water in near-critical and supercritical regions. Pt. 1. Twice-differential cross sections of slow neutron scattering by water in near-critical and supercritical states.** Lisichkin, Yu.V.; Iskenderov, S.M.; Novikov, A.G.; Fomichev, N.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700860.

The experiment for obtaining absolute twice-differential cross sections (TDC) of E_0=7.25 MeV neutron scattering by water and water vapour at a temperature of 360 to 400 deg C in a wide density range (from 0.32 g/cm^3 to 0.005 g/cm^3) is described. The experimental curves are compared with calculations performed for three dynamic scatterer models: liquid water, ideal gas of H_2O monomer molecules and that of $(H_2O)_2$ dimers. None of the mentioned models describes experimental TDC of scattering in the whole investigated density range. In subcritical state (T=600 to 630 K) experimental TDC of scattering are satisfactorily described by the liquid model. In supercritical state (T=673 K) at densities rho < or approximately 0.02 g/cm^3, experimental TDC of scattering are satisfactorily described by the ideal gas model of freely rotating water molecules. The ideal gas model of $(H_2O)_2$ dimers turns out to be inadequate to the experimental data.

24815 **(FEI—1451) Subgroup calculation of plane-parallel systems. Part 1. Calculation method.** Pivovarov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700861.

Results of developing a technique of subgroup solution of transition equation in media with a strong resonance cross section structure, are presented. The subgroup approach permits to take into account the spatial dependence of selfscreening of group cross sections which is mainly vivid in heterogeneous cells close to separation boundaries of physical zones in thick layers of resonance disperser. The solution of this problem has practical value for problems of homogenization of cells and preparation of constants for shielding calculation. It also can be used for methodic investigations in the estimate of errors of the group method.

24816 **(IC—84/91) Pade approximant calculations for neutron escape probability.** El Wakil, S.A.; Saad, E.A.; Hendi, A.A. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700545.

The neutron escape probability from a non-multiplying slab containing internal source is defined in terms of a functional relation for the scattering function for the diffuse reflection problem. The Pade approximant technique is used to get numerical results which compare with exact results.

24817 **(IC—84/135) Theory of neutron scattering in disordered alloys.** Yussouff, M.; Mookerjee, A. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1984. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700544.

A comprehensive theory of thermal neutron scattering in disordered alloys is presented here. We consider in detail the case of substitutional random binary alloy with random changes in mass and force constants; and for all values of the concentration. The cluster CPA formalism in augmented space developed here is free from analytical difficulties for the Green function, performs correct averaging over random atomic scattering lengths and employs a self-consistent medium for the calculations. For easy computation, we describe the graphical representation of the resolvent where the approximation steps can be depicted as closed paths in augmented space. Our results for scattering cross sections, both coherent and incoherent, include new types of terms and these lead to asymmetric line shapes for the coherent scattering.

24818 **(IFUSP-P—409) Stopping of silver ions in solids.** Ribas, R.V.; Seale, W.A.; Rao, M.N. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jun 1983. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700502.

The stopping of Ag ions recoiling through Al, Ti, V, Fe, Ni, Zn, Zr, and Pd was measured at various recoil energies with a method based on the Doppler shift of gamma rays. The dependence of the electronic stopping cross section on the stopper atomic number and on recoil velocity is compared to the semi-empirical predictions of Ziegler et al.

24819 **(PUC-TN—14/82) Universal equation for the electronic stopping of ions in solids.** Montenegro, E.C.; Cruz, S.A.; Vargas-Aburto, C. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Sep 1982. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700511.

An analytical equation for the electronic stopping of ions in solids for non-relativistic velocities, that has no adjustable parameters, is obtained in a semi-phenomenological manner. The very good agreement with experiment gives support to the physical arguments used in its derivation.

24820 **Measurement of positron reemission from thin single-crystal W(100) films.** Chen, D.M.; Lynn, K.G.; Pareja, R.; Nielsen, B. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **31**: No. 7, 4123-4130(1 Apr 1985).

Epitaxial thin single-crystal (100) tungsten films 1000, 2500, and 5000 A thick have been fabricated by high-vacuum electron-beam evaporation. These films were subsequently used as thin-film moderators for the study of the positron-transmission-reemission process with a variable-energy (0—80 keV) monoenergetic positron beam in an ultrahigh-vacuum system. The films were shown to be routinely cleanable by heating first in oxygen (10^{-6} Torr) and then in vacuum (10^{-9} Torr). Transmission and back reemission of slow

positrons from these surfaces was observed. The positron work function, phi/sub +/ has been determined to be ≃3.0 eV (+- 0.3 eV). The transmission slow positrons were emitted in a narrow cone with a full width at half maximum of ≃30° consistent with the angular distribution of back-reemission positrons. The reemitted yields as a function of incident positron energy were found to be very different between forward reemission and back reemission. The maximum forward-reemission yields were 18% for 1000-A-thick W film and 12% for 2500-A-thick W film at 5 and 10 keV optimum incident positron energies, respectively. These results show that one can use thin single-crystal tungsten films as positron moderators or remoderators.

24821 **Influence of damping in an electron gas on wake binding energies.** Ashley, J.C.; Echenique, P.M. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **31**: No. 7, 4655-4656(1 Apr 1985).

The binding energies of electrons trapped in the oscillatory wake of electron-density fluctuations trailing a fast ion in a solid are shown to decrease with increasing damping in an electron gas.

24822 **Relativistic corrections to stopping powers.** Anderson, V.E.; Ritchie, R.H.; Sung, C.C.; Eby, P.B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] A: General Physics;* **31**: No. 4, 2244-2247(Apr 1985). Contract AC05-84OR21400.

Relativistic corrections to the nonrelativistic Bethe-Bloch formula for the stopping power of matter for charged particles are traditionally computed by considering close collisions separately from distant collisions. The close-collision contribution is further divided into the Mott correction, appropriate for very small impact parameters, and the Bloch correction, computed for larger values. This division of the region of close collisions leads to a very cumbersome result if one generalizes the original Bloch procedure to relativistic energies. We avoid the resulting poorly specified scattering angle θ_0 that divides the Mott and Bloch correction regimes by using the procedure suggested by Lindhard and applied by Golovchenko, Cox, and Goland to determine the Bloch correction for relativistic velocities.

24823 **Time-dependent radiative transfer with automatic flux limiting.** Mihalas, D.; Weaver, R. (Sacramento Peak Observatory, Sunspot, NM). *Journal of Quantitative Spectroscopy and Radiative Transfer;* **28**: No. 3, 213-222(1982).

A simple method for solving the time-dependent transfer problem is discussed. This scheme is automically flux-limited and affords physical insight into how flux limitation occurs. A second-order, time-dependent radiation energy equation is then developed that is similar in form to the diffusion-limit radiation energy equation. This time-dependent energy equation approaches physically reasonable equations in optically thick and thin regions. Computational aspects of solving this energy equation are discussed. 14 references.

6550 Medical Physics

REFER ALSO TO CITATION(S) 23589, 24270

24824 **(JAERI-M—83-134) Health physics in JAERI, No. 25. April 1, 1982-March 31, 1983.** (Japan Atomic Energy Research Inst., Tokyo). Oct 1983. 231p. (In Japanese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85700900.

In the annual report No. 25 (fiscal 1982) are described the activities of health physics including radioactive waste management in Tokai Research Establishment, Takasaki Radiation Chemistry Research Establishment and Oarai Research Establishment. Technology developments were made as in the previous years for improving the techniques and methods in monitoring of individuals, facilities and environment, radiation measurement instrumentation and also in waste management and decontamination. The following works were made in the researches of radiation dosimetry, body radioactivity and airborne radioactivity. For radiation dosimetry: a radiation leakage-path analysis code to estimate the skyshine dose from fusion facilities, shielding effect of buildings for radiation from radioactive effluent released in reactor accidents, distribution apparatus for gaseous tritium standard sources to calibrate low-level tritium monitors, characteristics of the Bremsstrahlung detection type tritium monitor for measuring intermediate tritium concentrations, and portable calibration apparatus using gaseous standard sources for gas monitors installed in facilities. For body radioactivity: investigation on materials suitable for a phantom used in the calibration of Pu lung counters, water balance test in the mouse for developing a reasonable method of enhancement of tritium excretion from the body, and experiment on the relationship between depth dose and chromosome aberration. For airborne radioactivity: adsorption of radioactive iodine gas onto fly ash aerosol at various iodine concentration, performance test of the cartridge containing silver alumina for selective collection of radioiodine in nuclear accidents, experimental analysis of air supply rate in protection performance of the powered air-supplying respirator, estimation of parameters of truncated lognormal distribution of aerosol size, and sheltering effect of houses for radioactive effluent.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 24022, 24057, 24103, 24124, 24128, 24586, 24588

24825 **(CBPF-NF—021/82) Fully anisotropic triangular lattice quenched bond-random Potts ferromagnet : almost exact critical frontier.** Tsallis, C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1982. 11p. (CONF-820929—15). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700495.

From IUPAP international conference on magnetism; Kyoto, Japan (6 Sep 1982).

Through convenient duality and star-triangle-type generalized transformations, a (presumably excellent for $1 <= q <= 4$) approximate phase diagram for the fully anisotropic triangular lattice quenched bond-random q-state Potts ferromagnet is obtained. Several exact particular results are recovered; a small error is however present in one of the limiting slopes.

24826 **(CBPF-NF—033/82) First- and second-neighbor square lattice Potts model : renormalization group treatment.** Oliveira, P.M.C. de; Tsallis, C.; Schwaccheim, G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1982. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700496.

Within a real space renormalization group framework, the q-state Potts model in square lattice assuming positive second-neighbor coupling constant and arbitrary sign for the first-neighbor one is studied. The q-evolution of the full phase diagram as well as the thermal and magnetic critical exponents is obtained. Whenever comparison with available results is possible, the agreement is either exact or very satisfactory.

24827 **(FEI—1413) Local biphonons in anharmonic crystals with defects.** Agranovich, V.M.; Dubovskij, O.A.; Orlov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700822.

The spectrum of binary bound phonon oscillations-biphonons in quasimolecular crystals with defects is investigated. Defects-isotopic substitution impurities and vacancies are considered. Derivation of the dispersion equation determining the spectrum of biphonon oscillations localized in the vicinity of defects is presented. The numerical solution results giving general ideas on the behaviour of terms of local biphonon oscillations in case of changes in determining parameters are presented.

24828 **(IC—84/59) Channelling radiation and applications to defects in solids.** Pathak, A.P. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1984. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700510.

Using one and two-dimensional hydrogen atom models (with quantum defect corrections) for planar and axial channelling of electrons and harmonic oscillator models in one and two-dimensions for planar and axial cases (with anharmonicity corrections) for positron channelling, some analytical results have been obtained for channelling radiation frequencies. The effects of extended defects (like dislocations) are then considered qualitatively. Some quantitative results are also obtained.

24829 **(IC—84/74) Effective mass theory for shallow donors in many valley semiconductors.** Balasubramanian, S.; Tomak, M. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700493.

The extensions to the conventional effective-mass theory for shallow donors in Si, proposed by Altarelli and Hsu on the one hand and Resta and Resca on the other, are examined in detail. A variational expression for the donor ground state energy is given including the effect of a band nearer to the conduction band minimum. The different contributions to the donor ground state in Si are discussed.

24830 **(IC—84/76) Surface polariton propagation along an interface between two metallized surfaces.** Nkoma, J.S. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700494.

Surface polaritons which propagate along an interface between two metallized surfaces are studied. The expressions for the dispersion relation, Poynting vector, energy density, energy velocity and the damping function are derived by electromagnetic theory. All these quantities are found to be frequency dependent and size dependent. Results are illustrated by a metal-vacuum-GaP-metal system.

24831 **(IC—84/82) Note on d-dimensional Ising model, S=1/2, with field.** Kulakowski, K. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700498.

Some approximate formulae are presented for the statistical potential Ω of d-dimensional Ising spin system, S=1/2, in a magnetic field. Only finite clusters are considered.

24832 **(IC—84/83) Overblocking effect for 2-spin interactions in some 3-dimensional structure.** Nencka-Ficek, H. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700499.

The overblocking effect is considered. The 3-dimensional structure on which the effect can arise is presented.

24833 **(IC—84/96) Topological closure as the necessary condition for frustration and phase transitions.** Nencka-Ficek, H. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700500.

It is shown that the same necessary conditions are necessary both for the frustration and the phase transition in the Ising models with multi-spin interactions.

24834 **(IFUSP-P—358) Introduction to the critical and multicritical phenomena.** Salinas, S.R.A. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1982. 71p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. File Number DE85700501.

The behavior of matter in the neighborhood of simple critical points is treated. The concepts of critical exponents and universality is introduced and the classical theories of the critical behavior and the phenomenological scaling theories of the thermodynamic functions and the critical correlations are described. Finally, a description of the theory of the renormalization group, which gives the microscopic bases of the scaling laws is ended. Four types of multicritical points which have already been detected in solid crystals tricritical, bicritical, tetracritical, and Lifshitz points are studied. Landa's theory and the formulation of the scaling laws in the neighborhood of these points is described. Also, the main features of some theoretical models which produce multicritical points-the Ising metamagnet and BEG model, which exhibit tricritical points, and the ANNNI model, which exhibits a Lifshitz point are described. The renormalization group approach in the Fourier space to the Ising metamagnet, and the new techniques of partial differential aproximants to analyze the scaling behavior in the neighborhood of the multicritical points are presented.

24835 **(PUC-TN—22/82) Exact results on the one-dimensional Potts lattice gas.** Riera, R.; Chaves, C.M.G.F. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Dec 1982. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700488.

An exact calculation of the Potts Lattice Gas in one dimension is presented. Close to T=O°K, the uniform susceptibility presents an essential singularity, when the excharge parameter is positive, and a power law behaviour with critical exponent γ=1, when this parameter is negative.

24836 **Statistical ensembles and molecular dynamics studies of anisotropic solids. II.** Ray, J.R.; Rahman, A. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **82**: No. 9, 4243-4247(1 May 1985).

We have recently discussed how the Parrinello—Rahman theory can be brought into accord with the theory of the elastic and thermodynamic behavior of anisotropic media. This involves the isoenthalpic—isotension ensemble of statistical mechanics. Nose has developed a canonical ensemble form of molecular dynamics. We combine Nose's ideas with the Parrinello—Rahman theory to obtain a canonical form of molecular dynamics appropriate to the study of anisotropic media subjected to arbitrary external stress. We employ this isothermal—isotension ensemble in a study of a fcc→close-packed structural phase transformation in a Lennard-Jones solid subjected to uniaxial compression. Our interpretation of the Nose theory does not involve a scaling of the time variable. This latter fact leads to simplifications when studying the time dependence of quantities.

24837 **Soluble models of rate processes in periodic systems with many degrees of freedom.** Vineyard, G.H.; Krumhansl, J.A. (Brookhaven National Laboratory, Upton, New York, 11973). *Physical Review [Section] B: Condensed Matter;* **31**: No. 8, 4929-4939(15 Apr 1985). Contract AC02-76CH00016.

We show that the parameters of classical many-body rate theory can be evaluated exactly for activated processes in large, chainlike systems. The methods are applied to four simple systems which simulate, in some degree, activated atomic motions in crystals. Each is a linear chain of atoms interacting with near-neighbor forces. One represents evaporation of an adatom from a surface, one an interstitialcy migration, one a vacancy migration, and one the motion of the interface between two phases. Exact analytical calculation of the parameters of many-body rate theory, namely the activation energy and the effective, or attack, frequency are given for each model. The results illustrate the role of cooperative effects in atomic jumps. The commonly made assumption that the attack frequency for such jumps is the characteristic lattice-vibration frequency is shown to be valid in some conditions, but to be a very poor approximation in others. For the evaporating adatom the relative mass of the adatom is allowed to be arbitrary. It is found that the transition rate is proportional to the square root of the relative mass for very light atoms, but otherwise the relative mass enters in a more complicated way, and, in particular, the transition rate remains finite for an adatom of infinite mass.

24838 **Real space solution to the phase problem in x-ray crystallography: ALCAMPS (Ames Laboratory computer-aided analysis of multisolution Patterson superpositions).** Richardson, J.W. Jr. Ames, IA; Iowa State Univ. (1984). 297p. University Microfilms Order No. 84-23,669.Contract W-7405-ENG-82.

Thesis (Ph. D.).

Beginning in the early 1930s, most crystal structures were solved from analysis of the Patterson function. In 1952, a series of

derivations revealed that crystal structures could be solved from the direct manipulation of the phases of Bragg reflections. The new approaches, known as direct methods, became immediately popular due to their relatively low computational requirements and their capacity to solve equal atom structures. Since that time, direct methods have become, to a large extent, the methods of choice. There are, however, structures which resist solution by direct methods. Through the years some researchers have continued to explore the intricacies of Patterson analysis. This research has developed to the point where complete structure determinations can now be made automatically on very complex structures. Reported here is an ab initio Patterson-based method, which is unique in that it requires no prior knowledge about the structure. This method has been automated in the form of a computer program called ALCAMPS. This dissertation will deal primarily with the theory and development of Patterson analysis, embodied in ALCAMPS, and its application to the solution of complex real crystal structures.

24839 **Anomalous quantum Hall effect - origin of fractional Hall steps.** Markiewicz, R.S.; Widom, A.; Sokoloff, J. (Northeastern Univ., Boston, MA). *Physical Review [Section] B: Condensed Matter;* 28: No. 6, 3654-3655(15 Sep 1983). Contract AC02-81ER10866.

It is shown that properly accounting for the magnetic compressibility of the two-dimensional electron system can lead to a monotonic quantum Hall coefficient with rational step heights. 15 references.

6561 Superconductivity

REFER ALSO TO CITATION(S) 24024, 24044, 24048, 24049, 24051, 24063, 24088, 24089, 24090, 24092, 24126, 24127, 24131

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 24165, 24594, 24595, 24596, 24710, 24836, 24889, 24891

24840 **(CBPF-MO—001/82) Topics of differential geometry in Hamiltonian and Lagrangian mechanics and relativity.** Rodrigues, P.R. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1982. 85p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. File Number DE85700449.

An introduction to the tensor and exterior algebra as to the differential geometry is made. Such a geometry is used in order to study the Hamiltonian and Lagrangian mechanics stressing their geometrical aspects. Some applications are done in relativity theory.

24841 **(CBPF-NF—048/82) Homogeneity of Riemannian space-times of Goedel type.** Reboucas, M.J.; Tiomno, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1982. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700462.

The conditions for space-time homogeneity of a Riemannian manifold with a Godel-type metric are examined. The Raychaudhuri-Thakurta necessary conditions are shown to be also sufficient and to lead to five linearly independent Killing vectors. These vector fields are exhibited for the most general case and their algebra are examined. The irreducible set of isometrically independent ST-homogeneous Godel-type metrics is shown to be given, in cylindrical coordinates, by $ds^2 = [dt + 4\Omega/m^2 \sinh^2(mr/2)\, d\,phi]^2 - 1/m^2 \sinh^2(mr)\, d\,phi^2 - dr^2 - dz^2$, where Ω is the vorticity and - infinity $< = m^2 < = +$ infinity, $m^2 = 2\Omega^2$ corresponding to the Godel metric. Sources of Einstein equations leading to these metrics as solutions are examined and it is shown that the inclusion of a scalar field extends the previously known region of solutions - infinity $< = m^2 < = 2\Omega^2$ to - infinity $< = m^2 < = 4\Omega^2$. The problem of ambiguity of physical sources of the same metric and that of violation of causality in Godel-type ST-homogeneous universes are examined. In the case $m^2 = 4\Omega^2$ the first exact Godel-type solution of Einstein equations describing a completely causal ST-homogeneous rotating universe is obtained.

24842 (CERN—84-09, pp 526-532) **Low energy particle spectrum from supergravity.** Kounnas, C. (Ecole Normale Superieure, 75 - Paris (France). Lab. de Physique Theorique). 8 Aug 1984. NTIS (US Sales Only), PC A25/MF A01. File Number DE85700841. (CONF-8403130—).

From 4. topical workshop on proton antiproton collider physics; Bern, Switzerland (5 Mar 1984).

We discuss the supergravity induced low energy supersymmetric particle spectrum. The radiative breaking of the SU(2) x U(1) gauge group is explained as well as the dynamical determination of the weak scale. In the framework of the 'no scale' supergravity models the vast hierarchy between the weak scale Msub(W) = 81 GeV and the fundamental supergravity scale $M = 2.4 \times 10^{18}$ GeV (Msub(W)/M = 10^{-16}) is shown to be dynamically generated in the quantum level.

24843 **(FEI—1426) Scattering theory elements in oscillator representation.** Asherova, R.M.; Nechaev, Yu.I.; Smirnov, Yu.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1983. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700789.

The problem of solving the Schroedinger equation for a particle in the V potential well in the framework of the oscillator representation both in the region of discrete and continuous spectrum is discussed. The Hamiltonian matrix of free motion in oscillator basis has three-diagonal form, which enables determination in the explicit form the regular and irregular solutions of equations of free motion in ocillator representation. The difference Schroedinger equation in oscillator representation in the limit of high values of n quantum number reduces to the normal Schroedinger equation for the problem of scattering on the nonlocal potential V(n, n') approximately $<n/V/n'>$. The problem of calculating scattering phases, energies of related states and resonances in the framework of oscillator representation is discussed. The illustration example of $delta_0$ phase S-scattering for the Gauss potential-calculation is considered.

24844 **(IFUSP-P—340) Geometry as an aspect of dynamics.** Videira, A.L.L.; Barros, A.L.R.; Fernandes, N.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Jun 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700463.

It is shown how the introduction from the onset, in a general differentiable space-time manifold, of a certain well defined minimal set of fundamental dynamical quantities allows the specific geometric structure of that manifold to be fixed.

24845 **(IFUSP-P—385) Finite proton-neutron mass difference.** Kimel, I. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Feb 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700477.

With the only assumption that the up-down quark mass splitting is a weak-electromagnetic radiative effect, the proton-neutron mass difference is shown to be finite. This happens in a new representation where the mass difference can be completely calculated (no unknown terms) in very good agreement with experiment.

24846 **(IFUSP-P—391) K-harmonics methods and the bound-state spectrum of one-dimensional three-body system.** Malta, C.P.; Coutinho, F.A.B. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Mar 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700452.

The symmetry properties of one-dimensional hyperspherical harmonics components have been investigated. For a system of three identical particles moving in one-dimension it is shown how to construct solutions of definite parity and definite transformation properties under permutation of any particle pair. General qualitative features of the spectrum of the one-dimensional system are deduced for particles satisfying Bose-Einstein, Fermi-Dirac and Boltzmann statistics.

24847 (IFUSP-P—395) General statistics and second quantization. Cattani, M.S.D.; Fernandes, N.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Apr 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700453.

In order to obtain commutation relations for the creation and annihilation operators for the para-particles in Quantum Mechanics, a somewhat new second quantization method is proposed. Its shown that for bosons and fermions the usual bi-linear commutation relations are valid and that for the para-particles the commutation relations have a multilinear matricial form. It is also shown that from a symmetric group point of view, it is hard to accept the paraboson and parafermion concepts in Quantum Mechanics.

24848 (IFUSP-P—399) Existence of bound states of N-particle systems in one- and two-dimensions. Coutinho, F.A.B.; Malta, C.P.; Perez, J.F. (Sao Paulo Univ. (Brazil). Inst. de Fisica). May 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700454.

Sufficient conditions are given for the existence, in one- and two-dimensions, of bound states of a system of N-particles interacting via two-body potentials.

24849 (IFUSP-P—421) General statistics, second quantization and quarks. Cattani, M.S.D.; Fernandes, N.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Aug 1983. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700455.

A somewhat new second quatization method is proposed in order to obtain commutation relations for intermediate states in quantum mechanics. These commutation rules are found to have a multilinear matricial form, whereas for bosons and fermions the usual bilinear relations are reobtained. It is shown that from a symmetric group point of view, it would be hard to accept the paraboson and parafermion concepts in quantum mechanics. Assuming that quarks can be represented by intermediate states, several properties of hadrons, such as quark confinement, baryonic number conservation, and 3-quarks saturation in baryons, seem to have a natural explanation.

24850 (IFUSP-P—424) Action-angle variables for the harmonic oscillator : ambiguity spin x duplication spin. Oliveira, C.R. de; Malta, C.P. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Aug 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700456.

The difficulties of obtaining a well defined unitary transformation to action-angle variables for the harmonic oscillator were overcome by M. Moshinsky and T.H. Seligman through the introduction of a spinlike variable (ambiguity spin) from a classical point of view. The difficulty of defining a unitary phase operator for the harmonic oscillator was overcome by Roger G. Newton also through the introduction of a spinlike variable (named duplication spin by us) but within a quantum framework. The relation between the ambiguity spin and the duplication spin by introducing these two types of spins in the canonical transformation to action-angle variables is investigated. Doing this it is possible to obtain both well defined unitary transformation and phase operator.

24851 (IFUSP-P—425) Elementary particle physics, phase transitions and cosmology. Marques, G.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Aug 1983. 26p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700464.

An overview about some problems in cosmology which has lead to an overlapping with others areas mainly, elementary particles and phase transition phenomena is made.

24852 (IFUSP-P—431) Some general properties of the point spectrum of three particles moving in one-dimension. Perez, J.F.; Malta, C.P.; Coutinho, F.A.B. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700458.

The eigenstates of three-particles moving in one-dimension are classified according to the S_1 plus parity group. The ordering of the ground state S_3 band is given for a fairly general class of potentials. Sufficient conditions are given both for existence and non-existence of bound states of a given symmetry.

24853 (IFUSP-P—432) Sufficient conditions for the existence of a bound state in the N-body problem. Perez, J.F.; Malta, C.P.; Coutinho, F.A.B. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700459.

Simple sufficient conditions for the existence of a bound state in the system of N particles interacting via a purely attractive two-body potential are provided. This method is based on a variational approach.

24854 (IFUSP-P—439) Energy independent optical potentials: construction and limitations. Hussein, M.S.; Moniz, E.J. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Nov 1983. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700460.

Properties of the energy-independent potential U sup(-) which is wave-function-equivalent to the usual optical potential U(E) are constructed and examined. A simple procedure is presented for constructing U sup(-) in the uniform medium, and physical examples are discussed. The general result for finite systems, a recursive expansion in powers of U(E), is used to investigate the multiple scattering expansion of U sup(-); the energy-independent potential is found to have serious short-comings for direct microscopic construction or phenomenological parametrization. The microscopic theory, as exemplified here by the multiple scattering approach, does not lead to a reliable approximation scheme. Phenomenological approaches to U sup(-) are unattractive because the physics does not guide the parametrization effectively: the structure of the nonlocality is not tied directly to the dynamics; Im U sup(-) changes sign; different elements of the physics, separate in U(E), are completely entangled in U sup(-).

24855 (IFUSP-P—445) Lower bound for the energy of the ground state of bosons moving in one dimension. Malta, C.P.; Perez, J.F.; Coutinho, F.A.B. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1983. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700461.

It is shown that the ground state energy of N bosons of mass m moving in one dimension is greater than $E = - m/16h/2\pi^2 N^2(N-1)]\int$ sup(+ infinite) sub(- infinite) V(x)dx] where V(x) is the two-body potential. It is conjectured that $E = - m/24h/2\pi^2 N(N^2-1)]\int$ sup(+ infinite) sup(infinite) $V(x)dx]^2$ provides a lower bound.

24856 (IFUSP-P—450-Rev.) Geometry as an aspect of dynamics. Videira, A.L.L.; Barros, A.L.R.; Fernandes, N.C. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Dec 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700800.

Contrary to the predominant way of doing physics, it is shown that the geometric structure of a general differentiable space-time manifold can be determined by means of the introduction in that manifold of a minimal set of fundamental dynamical quantities associated to a particle endowed with the fundamental property of covariant momentum. Thus, general relativistic physics implies a general pseudo-Riemannian geometry, whereas the physics of the special theory of relativity is tied up with Minkowski space-time, and Newtonian dynamics is bound to Newtonian space-time. While in the relativistic instance, the Riemannian character of the manifold is basically fixed by means only of the Hamiltonian state function of the particle (its energy), in the latter case, one have to resort, perhaps not unexpectedly, to the two dynamical entities mass energy, separately.

24857 (IFVE-OTF—83-141) Classification problem for exactly integrable embeddings of two-dimensional manifolds and coefficients of the third fundamental forms. Saveliev, M.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700790.

A method is proposed for classification of exactly and completely integrable embeddings of two dimensional manifolds into Riemann or non-Riemann enveloping space, which are based on the algebraic approach to the integration of nonlinear dynamical systems. Here the grading conditions and spectral structure of the

Lax-pair operators taking the values in a graded Lie algebra that pick out the integrable class of nonlinear systems are formulated in terms of a structure of the 3-d fundamental form tensors. Corresponding to every embedding of three-dimensional subalgebra sb(2) into a simple finite-dimensional (infinite-dimensional of finite growth) Lie algebra L is a definite class of exactly (completely) integrable embeddings of two dimensional manifold into the corresponding enveloping space supplied with the structure of L.

24858 **(INIS-BR—152) Generalized treatment of point canonical transformations in the path integral.** Girotti, H.O.; Simoes, T.J.M. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). [1985]. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85780818.

Non-linear point canonical transformations within the path integral are investigated when an arbitrary discrete procedure is used for defining such integral. A complete derivation of the so called additional potential is given in this general case. An extension of the average method of McLaughlin and Schulman is also presented.

24859 **(INIS-mf—9504) Necessity and sufficiency of local commutativity for causality in quantum mechanics.** Muynck, W.M. de. (Amsterdam Univ. (Netherlands)). 9 May 1984. 128p. NTIS (US Sales Only), PC A07/MF A01. File Number DE85780819.

Includes Dutch summary.

This thesis contributes to the resolution of the question whether quantum mechanics admits an objectivistic interpretation if the description is restricted to the phenomenalistic domain of the quantum mechanical observables. Without touching the realism-phenomenalism dichotomy, this thesis investigates the possibility to disregard the influence of the measurement interaction on the qm measuring results. In the first part, the measuring process is studied and its influence on the objectivity of measuring results. The measurement of a local observable is interpreted as a local operation. Its local commutativity is a necessary condition for macrocausality. In the second part the converse question is studied, viz. Whether local commutativity is sufficient for macrocausality.

24860 **(INS—477) Solution of the stationary vacuum equations of relativity for conformally flat 3-spaces.** Perjes, Z.; Lukacs, B.; Sebestyen, A.; Valentini, A.; Sparling, G.A.J. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Aug 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700801.

The solution of Einstein's vacuum gravitational equations for stationary space-times with a conformally flat 3-space is presented. There is no other solution of this problem than the Ehlers-rotation generalizations of the three conformastat space-times including the Schwarzschild metric.

24861 **(IPPJ—641) Considerations on the equations of the three-wave interactions.** Kawata, Tsutomu. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1983. 58p. NTIS (US Sales Only), PC A04/MF A01. File Number DE85700791.

As a typical case of higher-order matrix in two dimensions, we discuss the third-order eigenvalue problem developed for the inverse spectral transform solving the equations of three-wave interactions. The third-order matrix equation is reformulated by the new mathematical concept, "Riemann-Hilbert problem", by which we give a simpler way to construct the soliton solution. Defining the Green function for the associated eigenvalue problem, we obtain the completeness relation of jost functions. Through variational computations, squared jost vectors are naturally introduced and the corresponding completeness is also obtained. According to the classical Green formula, we define another type of Green function for the linearized partial differential equation of the three-wave interactions. By this type of Green function we solve the non-homogeneous linear differential equation, which appears in perturbations of the three-wave interactions.

24862 **(ITEF—13(1983)) Stable in C metric approximate solution of singular equations, solvable in a closed form.** Matveev, A.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 26p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700785.

A stable in C metric method of approximated solutions of singular integral equations (SIE) and singular integro-differential equations (SI-DE) with the Cauchy nucleus, which are solvable in a closed form, has been suggested. Quadrature formulas for the singular integral on a fragment in a circumference are considered. An approximate solution of characteristic SIE on a fragment and in a circumference is presented.

24863 **(ITEF—94(1983)) Group analysis of dynamical systems. Some problems.** Petukhov, V.R. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 22p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700786.

It is established that an existence of the group invariant allows one to accomplish (incomplete) separation of motions. Problems of realization of discrete systems on some manifolds are investigated along with invatiant manifolds determined by functional equations.

24864 **(ITEP—179(1983)) Summation of perturbation series in quantum mechanics.** Eletsky, V.L.; Weinberg, V.M.; Popov, V.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE85700793.

Higher orders of perturbation series (PS) in quantum mechanics and field theory rise factorially at k → infinity (k is the perturbation theory order). The results of calculations of higher orders of perturbation theory and their relation to classical mechanics are discussed. Pade approximants and Pade-Borel transformation are used to sum the divergent PS E(g)=Σsub(k)Esub(k)gsup(k) in various quantum mechanical problems. It is demonstrated that these methods allow one to recover with a high accuracy the energy E(g) of a level (real, virtual or quasistationary) for a wide range of coupling constant g including the strong coupling region. A nonstandard perturbation theory leading to a sequence of rapidly convergent approximations is briefly discussed.

24865 **(JINR—E-2-84-21) Atkinson-Pruefer transformation and the eigenvalue problem for coupled systems of the Schroedinger equations.** Adamova, D.; Ulehla, I.; Horejsi, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 12p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700787.

The matrix generalization of the Pruefer transformation introduced by Atkinson is applied to a coupled system of the radial Schroedinger equations. It is shown that the phase functions corresponding to the matrix case exhibit properties analogous to those of the Pruefer phase function encountered in the scalar case. Rigorous theorems are established which allow one to determine the eigenvalues of the original Schroedinger system with an arbitrary accuracy provided that the asymptotic behaviour of the phase functions is known. The possibility of obtaining the phase functions by means of the integration of an appropriate system of nonlinear 1st order differential equations is briefly discussed.

24866 **(JINR—E-2-84-49) Improved Rosen's conditions on bound states of Schroedinger operators.** Exner, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700796.

We derive a necessary condition on a Schroedinger operator H=-Δ+V on Lsup(2)(Rsup(d)), d>=3 to have a bound state below a given energy epsilon, and a lower bound to the ground-state energy of H. These conditions are expressed in terms of the potential V alone, and generalize the recent results of Rosen to the

dimensions d>3 and to the potentials that are not necessarily rapidly decreasing. Some examples are given.

24867 (JINR—E-2-84-51) Some simple conditions of bound states of Schroedinger operators in dimension d >= 3. Exner, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700797.

A necessary condition for existence of bound states below a given energy of a Schroedinger operator H=-Δ+V on L^2 (Rsup(d)), d>=3, together with a lower bound to the ground-state energy of H are derived using the Sobolev inequalities. It generalizes some recent results to the dimensions d>3 and to the potentials that are not necessarily rapidly decreasing. Comparison to other known necessary conditions is given. The examples of the d-dimensional hydrogen-like atom and the d-dimensional harmonic oscillator are discussed. In both of them the bound to the ground-state energy becomes remarkably tight for large values of d.

24868 (JINR—E-17-83-874) Geometrical identification of quantum and information theories. Caianiello, E.R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700794.

Submitted to the journal Theor. Math. Phys. .

The interrelation of quantum and information theories is investigated on the basis of the conception of cross-entropy. It is assumed that "complex information geometry" may serve as a tool for "technological transfer" from one research field to the other which is not connected directly with the first one. It is pointed out that the "infinitesimal distance" ds^2 and "infinitesimal cross-entropy" dHsub(c) coincide.

24869 (JINR—E-17-84-22) Nonequilibrium statistical averages and thermo field dynamics. Marinaro, A.; Scarpetta, Q. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700795.

Submitted to the journal Theor. Math. Phys. .

An extension of thermo field dynamics is proposed, which permits the computation of nonequilibrium statistical averages. The Brownian motion of a quantum oscillator is treated as an example. In conclusion it is pointed out that the procedure proposed to computation of time-dependent statistical average gives the correct two-point Green function for the damped oscillator. A simple extension can be used to compute two-point Green functions of free particles.

24870 (JINR—R-2-83-897) Deviation equations in spaces with affine connection. Iliev, B.; Manov, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700802.

The connection between Lie derivatives and the deviation equations has been investigated in spaces Lsub(n) with affine connection. On this basis the deviation equations of the geodesics have been obtained as well as deviation equations of nongeodesic trajectories, through imposing certain conditions on the Lie derivatives with respect to the tangential vector of the basic trajectory.

24871 (JINR—R-2-84-71) Connection of space and time coordinates. Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1984. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700803.

Spinor coordinates including the konwn light front variables are considered. It is shown that their application simplifies the formulation of relativistic kinematics. It is noted that those applied in high energy physics values-rapidity, characteristics of parton model of elementary particles (effective Hamiltonian, a fraction of subsystem longitudinal momentum etc.), cumulative number a.o. are compiled practically from spinor variables. Proceeding from conventional character of definition of concepts of simultaneity and distance it is pointed to a possibility to introduce some kind of time-spatial gauge. It is also noted that due to the relation between space and time coordinates there exists the relation between space and time reflections.

24872 (JINR—R-2-84-211) Elliptic basis of circular oscillator. Mardoyan, L.G.; Pogosyan, G.S.; Ter-Antonyan, V.M.; Sisakyan, A.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700798.

Submitted to the journal Nuovo Cim., A.

A general scheme is developed for constructing the elliptic basis of circular oscillator. Formulae are obtained for the calculation by computer, the behaviour of the elliptic basis is established in Cartesian and polar limits, and some particular results are presented.

24873 (JINR—R-4-84-28) Finite-dimensional approximation of a differential operator in problems of quantum mechanics. Belyaev, V.B.; Kartavtsev, O.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1984. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700799.

Submitted to the journal J. Comput. Phys. .

A second-order differential operator is approximated by an approximate operator that coincides with the exact one on some finite number of functions. The approximate operator is a linear combination of integral operators. This approximation is used to solve the scattering and the bound-state problem for the Schroedinger equation.

24874 (JINR-R—5-84-75) Convergence of expansions of continuum functions on resonance wave functions. Kazacha, G.S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1984. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700788.

The convergence of the expansions of the continuum wave function psisub(l)sup(+) (kx) and of the Green function Gsub(l)sup(+)(k, x, x') for x, x'in the interval (O, a) is studied. The resonance functions are solutions of the eigenvalue problem for the radial Schroedinger equation with boundary conditions corresponding to the case when there is only an outgoing wave on x>a. The eigenvalues ksub(n) corresponding to the resonance functions are the poles of meromorphic functions psisub(l)sup(+)(kx) and Gsub(l)sup(+)(k, x, x'). By Mittag-Leffler theorem these functions may be represented as sum of the principal parts and the polynimial Q(k) of degree p. It is proved that in the case of finite range potential, satisfying the condition q(a-O) not equal to 0, the Mittag-Leffler expansions are uniformly convergent in the interval [O, a), for p>=1, and in the interval [O, a-delta) for p=-1.0.

24875 (LBL—19200) Magnetic charge and non-associative algebras. Guenaydin, M.; Zumino, B. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). Feb 1985. Contract AC03-76SF00098. 12p. (CONF-8410235—2). NTIS, PC A02. File Number DE85009931.

From Old and new problems in fundamental physics meeting (in honor of G. C. Wick); Pisa, Italy (25 Oct 1984).

We consider the possibility that the quantum mechanics of a nonrelativistic electron in the magnetic field of a magnetic charge distribution can be described in terms of a non-associative algebra of observables. It appears that the case of a point monopole is excluded, while that of a constant charge distribution is acceptable. 21 references.

24876 (UWThPh—84-37) Equivalence of electromagnetic and clock-transport synchronization in noninertial frames and gravitational fields. Rumpf, H. (Vienna Univ. (Austria)). 1984. 5p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700468.

Synchronization by slow clock transport is shown to be equivalent for electromagnetic signals for clocks moving along the trajectories of a timelike Killing vector field, provided the gravitational redshift is corrected for and the synchronization paths are the same.

24877 (UWThPh—84-38) Simple proof of the generalized electrostatic Israel theorem. Simon, W. (Vienna Univ. (Austria)). 1984. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700469.

A simple proof of a generalization of the theorem of Israel concerning the uniqueness of the Reissner-Nordstroem black holes is presented. The present method is also applied to show, in the bosonic sector of N = 4-supergravity, the uniqueness of a static black hole solution found by Gibbons.

24878 Nontrivial zeros of the Racah quadrupole invariant. Brudno, S.; Louck, J.D. (Chicago College of Osteopathic Medicine, Chicago, Illinois 60615). *Journal of Mathematical Physics (New York);* **26**: No. 6, 1125-1127(Jun 1985). Contract W-7405-ENG-36.

It is shown that a class of nontrivial zeros of the Racah quadrupole invariant operator is given by two orbits of the group action of an infinite discrete subgroup of the proper two-dimensional Lorentz group SO(1,1) on the hyperbola $4x^2-3y^2 = (11)/(4)$.

24879 Chiral and gravitational anomalies in any dimension. Delbourgo, R.; Matsuki, T. (Department of Physics, University of Tasmania, Hobart, Tasmania, Australia 7001). *Journal of Mathematical Physics (New York);* **26**: No. 6, 1334-1336(Jun 1985). Contract AS05-77ER05490.

Gravitational contributions to the chiral anomaly in 4N space-time dimensions as well as the purely gravitational anomaly in 4N-2 dimensions are expressed in terms of the Riemann—Christoffel tensor. Using this formula, we give a simple proof that if N > or = 4 there is no way to cancel the gravitational anomalies using fields of spin- 1/2 , - (3)/(2) , and -1.

24880 Scattering by a spherical inhomogeneity in a fluid-saturated porous medium. Berryman, J.G. (Lawrence Livermore National Laboratory, University of California, P.O. Box 808, L-201, Livermore, California 94550). *Journal of Mathematical Physics (New York);* **26**: No. 6, 1408-1419(Jun 1985). Contract W-7405-ENG-48.

A fast compressional wave incident on an inhomogeneity in a fluid-saturated porous medium will produce three scattered elastic waves: a fast compressional wave, a slow compressional wave, and a shear wave. This problem is formulated as a multipole expansion using Biot's equations of poroelasticity. The solution for the first term (n = 0) in the multipole series involves a 4 x 4 system which is solved analytically in the long-wavelength limit. All higher-order terms (n > or = 1) require the solution of a 6 x 6 system. A procedure for solving these equations by splitting the problem into a 4 x 4 system and a 2 x 2 system and then iterating is introduced. The first iterate is just the solution of the elastic wave scattering problem in the absence of fluid effects. Higher iterates include the successive perturbation effects of fluid/solid interaction.

24881 Scaling behavior of windows in dissipative dynamical systems. Yorke, J.A.; Grebogi, C.; Ott, E.; Tedeschini-Lalli, L. (University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **54**: No. 11, 1095-1098(18 Mar 1985).

Global scaling behavior for period-n windows of chaotic dynamical systems is demonstrated. This behavior should be discernible in experiments.

24882 Possible tests and improvements for Monte Carlo renormalization-group studies. Murthy, G.; Shankar, R. (J. W. Gibbs Laboratory of Physics, Yale University of New Haven, Connecticut 06520). *Physical Review Letters;* **54**: No. 11, 1110-1113(18 Mar 1985). Contract AC02-76ER03075.

Exploiting the solvability of the d = 2 nearest-neighbor Ising model we construct the critical surface in a thirteen-dimensional parameter space in the vicinity of the nearest-neighbor transition point. We see if the flows generated from this point by recent Monte Carlo renormalization-group transformations lie on this surface. We clarify and quantify the effects of truncation. We unearth a truncation scheme that should speed up the convergence to the fixed point even in d = 3. .AE

24883 Microwave generation from filamentation and vortex formation within magnetically confined electron beams. Peratt, A.L.; Snell, C.M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **54**: No. 11, 1167-1170(18 Mar 1985).

The generation of microwaves from interacting vortices formed in thin magnetized electron beams is investigated experimentally and with three-dimensional electromagnetic particle simulations. Fine-detail photographs of relativistic and nonrelativistic beams show that vortex formation transcends 12 orders of magnitude in beam current. The simulations show a burst of microwave radiation from a rapid magnetic line connection and breaking between vortices when the vortex structure is well defined.

24884 Wigner distribution function - 50th birthday. O'Connell, R.F. (Louisiana State Univ., Baton Rouge). *Foundations of Physics;* **13**: No. 1, 83-92(1983). Contract AS05-79ER10459.

The profound influence which the Wigner distribution function has had in many areas of physics during its fifty years of existence is discussed. 50 references.

24885 Medium-dependent dynamics in Fermi systems from a pair-composite viewpoint. Goldberg, A.; Puff, R.D. (Lawrence Livermore National Lab., CA). *Journal of Statistical Physics;* **33**: No. 3, 571-594(1983). Contract W-7405-ENG-48.

The authors examine the effects of medium dependence of the two-body dynamics on the many-body properties of Fermion systems, with approximation ultimately aimed at lower densities for all temperatures. The dynamics are initially treated in terms of a pair-composite formulation given previously, and the underlying single-Fermion nature of the pair constituents allows interpretation via more conventional thermal many-body formalism. This permits construction of coupled equations for composite amplitudes and bound states, single-particle energy and momentum distributions, and macroscopic thermodynamic properties. The authors explore differences between their results and those of traditional theories which incorporate two-body correlations in some fashion, and we display explicitly how correct limiting results are recovered from their equations when the density and/or coupling strength is decreased. Finally, they provide an interpretation of their results via a form of quasiparticle quantum cluster expansion analogous to the familiar particle quantum cluster expansion.

24886 Short-pulse 1064-nm exposure fluences of panchromatic and infrared emulsions: evidence for production of photographic images by nonlinear absorption of light. Milam, D. (Lawrence Livermore National Lab., CA). *Photographic Science and Engineering;* **26**: No. 4, 171-175(Jul-Aug 1982). Contract W-7405-ENG-48.

Beam profiles of 1064-nm lasers operating at pulse durations between 0.15 and 50 ns were recorded on a panchromatic emulsion, Polaroid Type 410 film, and an infrared emulsion, Kodak I-Z spectroscopic plates. The exposure fluence required for both emulsions increased as the pulse duration increased, even though all pulse durations were short compared to ionic and electronic diffusion times in silver halide crystals. This unusual reciprocity failure suggests the photographic process resulted from a nonlinear absorption of light.

24887 Analytic phase shifts for Yukawa potentials. Green, A.E.S.; Rio, D.E.; Schippnick, P.F.; Schwartz, J.M.; Ganas, P.S. (Univ. of Florida, Gainesville). *International Journal of Quantum Chemistry, Symposium;* **16**: 331-343(1982). Contract AS05-76EV03798.

The Yukawa or Debye-Hueckel potential, by a suitable choice of scale factor (d) and the use of the corresponding energy unit ($h^2/2md^2$), may be written in the form V(r:Z) = -(2Z/r)e/sup -r/. For Z much less than 1 or l much greater than 1 or E = k^2 sufficiently large the partial wave phase shifts are given by the Born approximation which mathematically vanishes at E = 0. On the other hand, Levinson's theorem indicates that a phase shift, in units of π, is equal to n(Z,l), the integral number of bound states sustainable by the potential. In this work an optical model code

written by Relyea for molecular potentials is adapted to be suitable for singular attractive potentials such as the Yukawa potential. This modified code is used to obtain the numerical Schroedinger phase shifts for a broad range of Z and l values. By the addition of integers to assure continuity of the phase shifts and the satisfaction of Levinson's theorem the authors obtain an array of continuous functions which, in effect, interpolate between the Levinson limit and the Born limit. Next, they find an accurate analytic characterization of the number of bound states n/sub a/ (Z,l) suggested by the Sommerfeld model. Finally, they develop a simple two-term analytic formula which interpolates between the Levinson limit and the Born limit and fits the rectified set of Schroedinger phase shifts quite well. In effect, they arrive at a four-dimensional function δ(E,l,Z,d) that should be useful as a convenient approximation in atomic, nuclear, particle, and plasma physics. 12 references, 9 figures, 2 tables.

24888 **Analytic phase shifts for Yukawa potentials.** Green, A.E.S.; Rio, D.E.; Schippnick, P.F.; Schwartz, J.M.; Ganas, P.S. (Univ. of Florida, Gainesville). *International Journal of Quantum Chemistry, Quantum Biology Symposium;* No. 16, 331-343(1982). Contract AS05-76EV03798.

The Yukawa or Debye-Hueckel potential, by a suitable choice of scale factor (d) and the use of the corresponding energy unit ($h^2/2md^2$), may be written in the form V(r:Z) = -(2Z/r)e/sup -r/. For Z much less than 1 or l much greater than 1 or E = k^2 sufficiently large the partial wave phase shifts are given by the Born approximation which mathematically vanishes at E = 0. On the other hand, Levinson's theorem indicates that a phase shift, in units of π, is equal to n(Z,l), the integral number of bound states sustainable by the potential. In this work we first adapt an optical model code written by Relyea for molecular potentials to be suitable for singular attractive potentials such as the Yukawa potential. This modified code is used to obtain the numerical Schroedinger phase shifts for a broad range of Z and l values. By the addition of integers to assure continuity of the phase shifts and the satisfaction of Levinson's theorem we obtain an array of continuous functions which, in effect, interpolate between the Levinson limit and the Born limit. Next we find an accurate analytic characterization of the number of bound states N/sub a/(Z,l) suggested by the Sommerfeld model. Finally we develop a simple two-term analytic formula which interpolates between the Levinson limit and the Born limit and fits the rectified set of Schroedinger phase shifts quite well. In effect we arrive at a four-dimensional function δ(E,l,Z,d) which should be useful as a convenient approximation in atomic, nuclear, particle, and plasma physics.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 24862, 24863, 24878, 24880, 25083

24889 **(IFUSP-P—427) How universal is the period doubling phenomenon in equations with quadratic nonlinearity.** Malta, C.P.; Oliveira, C.R. de. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700457.

Varying one parameter, the solution of nonlinear 1 sup(st) order differential equation with time delay tau is Fourier analysed. After the Hopf bifurcation, period-doubling phenomenon always occurs when tau is one of the fixed parameters (both for small and large tau). Varying tau, there are values of the fixed parameters for which no period-doubling occurs. 'Chaos' follows the period-doubling sequence and the rate at which 'chaos' is approached is very close to the universal delta = 4.6692016... characterising the period-doubling sequence to chaos in nonlinear difference equations.

24890 **Symmetries of the higher-order KP equations.** Case, K.M. (The Rockefeller University, 1230 York Avenue, New York, New York 10021). *Journal of Mathematical Physics (New York);* **26**: No. 6, 1158-1159(Jun 1985). Contract AC02-81ER10807.

Symmetry generators T/sup(l/)/sub n/ = tI/sub n/+L/sup(l/)/sub n/ are constructed for the lth-order Kadomtsev—Petviashvili (KP) equation for all n > or = l-2. In the case of the ordinary KP equation (l = 2) these symmetries are those found by Chen et al. [Physica D 9, 439 (1983)].

24891 **Theorem on linearized Hamiltonian systems.** Case, K.M. (The Rockefeller University, 1230 York Avenue, New York, New York 10021). *Journal of Mathematical Physics (New York);* **26**: No. 6, 1201-1202(Jun 1985). Contract AC02-81ER10807.

Many nonlinear field equations can be written in Hamiltonian form. Thus the equation partial/sub t/u = K(u) can be written partial/sub t/u = [u, H], where H is an appropriate functional and [,] is a Poisson bracket. Frequently one is interested in the solution of the equation linearized about a given solution, i.e., the equation partial/sub t/ tau = K'(tau), where K'(tau) = (d/dε) K(u+εtau)'= 0. It is known that if a functional I is a constant of motion then tau = [u, I] is a solution. Recently, more general solutions of this form have been found. To prove these results, it is very useful to have the answer to the following question: If I/sub i/, I/sub j/ are two functionals, and K/sub i/ = [u, I/sub i/], what is K/sup prime// sub i/(K/sub j/)? The answer is K/sup //sub i/(K/sub j/) = [[u, I/sub i/], I/sub j/]. Previously, this was proved assuming that canonical coordinates can be introduced. Here a proof is given without any such assumption.

24892 **Seasonal adjustment evaluation from the residuals.** Tian, C.J.; Zhong, Y.Q. (Brookhaven National Lab., Upton, NY). pp 23-33 of Time series analysis: theory and practice 4. Anderson, O.D. (ed.). Dordrecht, Netherlands; Elsevier Science Publishers B.V. (1983). Contract AC02-76CH00016.

In this paper, some properties of superposed periodic series are studied. The results indicate that we may evaluate an estimate for the seasonal component of a time series from the residuals on an interval with sufficient length. In particular, when the periods of the seasonal component are integers, we may inspect an estimate for the seasonal component from the residuals on an interval whose length is no less than the sum of those corresponding periods. On the other hand, if the inspection of an estimate for the seasonal component is carried out on an inadequate interval, then the evaluation is no longer assured. 11 references.

6590 Communication, Education, History, And Philosophy

24893 **(LBL—19145) Bergson and the unification of the sciences.** Stapp, H.P. (Lawrence Berkeley Lab., CA (USA)). Feb 1985. Contract AC03-76SF00098. 11p. (CONF-8402144—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009961.

From Conference on Bergson and modern science; Galveston, TX, USA (8 Feb 1984).

Louis De Broglie and M. Capek have described some interesting similarities between the philosophical ideas of Henri Bergson and the profound conceptual changes introduced into physics by quantum theory and the theory of relativity. These similarities are neither identities nor direct causal links, and hence physicists are likely to regard them as mere curiosities having no import for the development of science. However, another view is possible: if Bergson's thinking presaged, at least in spirit, these two revolutionary advances in physics then his intuitions may accord sufficiently with nature to provide useful guidance in the approach to other deep problems in science. Pursuing this idea I shall indicate here how Bergson's intuitions suggest a possible approach to perhaps the fundamental problem of contemporary science, namely the problem of constructing an overarching theoretical framework for unifying the various branches of science from psychology through biology to physics. 19 refs.

70 FUSION ENERGY

24894 **(DOE/ER—0224) Annual report to the working group on technology, growth and employment. Summit Working Group on Controlled Thermonuclear Fusion.** (USDOE Office of Energy Research, Washington, DC). Apr 1985. 104p. NTIS, PC A06/MF A01; GPO Dep. File Number DE85010320.

The Summit Working Group in Controlled Thermonuclear Fusion was established in 1983 in response to the Declaration of the Heads of State and Government at the Versailles Economic Summit meeting of 1982 (Appendix A), and in response to the subsequent report of the Working Group in Technology, Growth and Employment (TGE) as endorsed at the Williamsburg Summit meeting, 1983. Representatives appointed by the governments of the seven Economic Summit countries (Canada, France, the Federal Republic of Germany, Italy, Japan, the United Kingdom and the United States) and a representative of the Commission of the European Communities met in Washington, DC on September 29 and 30, 1983 under the co-leadership of the United States and the European Communities. A report of the conclusions of this meeting has been published and a progress report was included in the TGE Working Group report to the 1984 London Summit (Appendix B). Following the London Summit, the fusion Working Group met in Brussels July 5 and 6 to consider the implementation of collaborative projects taking into account the conclusions issued in the Communique from London (Appendix C) and the recommendations of the TGE report.

7001 Plasma Research

REFER ALSO TO CITATION(S) 24541, 24579, 25071

24895 (CONF-790622—, pp 136-147) **Long arc simulated lightning attachment testing using a 150 kW Tesla coil.** Golka, R.K. (Project Tesla, Wendover AFB, Utah; Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Recent advances in direct lightning strike testing have been in lightning attachment test techniques and generator development using a very large Tesla Coil (51 feet wide). Breakthroughs in simulated lightning attachment to small scale replica aircraft models which can be adapted to full size operational aircraft have been made in the past year. New high voltage long arc generator developments have succeeded in producing voltages in excess of 15 million volts and arc lengths in excess of 40 feet. The shortest path from the discharge arc electrode to the model extremity using the long arc does not govern the attachment points to the test specimen as it does when a short arc is used to conduct simulated lightning testing. The system just described may also have application as an ultra-high mega-volt source for particle beam weaponry.

24896 **(CONF-850610—25) New concept for a wall detector for alpha particles.** Miley, G.H.; Kislev, H.; Micklich, B.J. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1985. Contract AC02-76ET52040. 6p. (COO—2218-313). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009037.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

A new concept for a wall-mounted detector is described here that would measure D-T alpha flux and corresponding pitch angle distribution in tokamaks (or related toroidal devices). The sensing element is a conical Micro Channel Ring (MCR) coated with 1 to 2μ of ZnS scintillator (or possibly ZnO). The collimation of the α particles is provided by two circumferential slots at the wall surface. The alpha scintillation events on the MCR are transferred through the ring channels and coupled fiber optics bundle to an external processor. From the magnetic field vector at a given point on the device wall, a certain relation can be set up between the α-induced scintillation position on the MCR and its original pitch angle (i.e., the angle between the α emission from the fusion reaction and the magnetic field vector) which is equal to the local pitch angle since the wall α flux is dominated by prompt losses.

24897 (DOE/ER/10275—1C, pp 1, Paper 19) **EBT and neutral hydrogen diagnostic.** Yun, V.E. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

24898 (DOE/ER/10275—1C, pp 1, Paper 21) **Coronal equilibrium impurity transport.** Bennett, R. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

24899 **(DOE/ER/53154—77) Confinement properties of high energy density plasmas in the Wisconsin levitated octupole.** Twichell, J.C. (Wisconsin Univ., Madison (USA)). Aug 1984. Contract AC02-83ER53154. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE85010182.

The confinement of particles and energy is critically dependent on the plasma-wall interaction. Results of a study detailing this interaction are presented. High power ICRF heated and gun afterglow plasmas were studied to detail the mechanisms determining particle and energy confinement. An extensive zero-D simulation code is used to assist in interpreting the experimental data. Physically reasonable models for plasma surface interactions, time dependent coronal treatment of impurities and multiple region treatment of neutrals are used in modeling the plasma. Extensive diagnostic data are used to verify the model. Non-heated plasmas decay from 28 to 3 eV allowing clear identification of wall impact energy thresholds for desorption and particle reflection. The charge state distribution of impurities verifies the reflux to plasma diffusion rate ratio. Close agreement between the simulation and experimental data is found.

24900 **(DOE/ET/53088—143) Effects of a radial electric field on tokamak edge turbulence.** Chiueh, T.; Terry, P.W.; Diamond, P.H.; Sedlak, J.E. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Mar 1985. Contract FG05-80ET53088. 48p. (IFSR—143). NTIS, PC A03/MF A01; GPO Dep. File Number DE85010401.

Turbulence associated with sheared radial electric fields such as those arising in tokamak edge plasmas is investigated analytically. Two driving mechanisms are considered: in the region of maximum vorticity (maximum electric field shear), the electric field is the dominant driving mechanism. Away from the maximum, turbulence is driven by the density gradient. In the latter case, previous work is extended to include the effects of the electric field on the spatial scales of density correlation in the frequency-Doppler-shifted density-gradient-driven turbulence. For radial electric field driven turbulence, the effects of magnetic shear on linear instability and on fully developed turbulence are examined. In the case of weak magnetic shear, saturation occurs through an enstrophy cascade process which couples regions of driving and dissipation in wavenumber space. For stronger magnetic shear, such that the resistive layer is comparable to the radial electric field scale length, saturation occurs through nonlinear broadening of the mode structure, which pushes enstrophy into the region of dissipation. Estimates of mode widths, fluctuation levels and scalings are obtained for both mechanisms. Comparison is made with the results of fluctuation measurements in the TEXT tokamak.

24901 **(DOE/ET/53088—170) Two-point theory of current-driven ion-cyclotron turbulence.** Chiueh, T.; Diamond, P.H. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Feb 1985. Contract FG05-80ET53088. 70p. (IFSR—170). NTIS, PC A04/MF A01; GPO Dep. File Number DE85010114.

An analytical theory of current-driven ion-cyclotron turbulenc which treats incoherent phase space density granulations (clumps) is presented. In contrast to previous investigations, attention is focused on the physically relevant regime of weak collective dissipation, where waves and clumps coexist. The threshold current for nonlinear instability is calculated, and is found to deviate from the linear threshold. A necessary condition for the existence of sta-

tionary wave-clump turbulence is derived, and shown to be analogous to the test particle model fluctuation-dissipation theorem result. The structure of three dimensional magnetized clumps is characterized. It is proposed that instability is saturated by collective dissipation due to ion-wave scattering. For this wave-clump turbulence regime, it is found that the fluctuation level (e psi/T/sub e/)/sub rms/ $\leq$ 0.1, and that the modification of anomalous resistivity to levels predicted by conventional nonlinear wave theories is moderate. It is also shown that, in marked contrast to the quasilinear prediction, ion heating significantly exceeds electron heating.

24902 **(DOE/ET/53088—173) Electromagnetic solitary waves in magnetized plasmas.** Hazeltine, R.D.; Holm, D.D.; Morrison, P.J. (Texas Univ., Austin (USA). Inst. for Fusion Studies; Los Alamos National Lab., NM (USA)). Mar 1985. Contract W-7405-ENG-36;FG05-80ET53088. 19p. (IFSR—173). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010084.

A Hamiltonian formulation, in terms of noncanonical Poisson bracket, is presented for a nonlinear fluid system that includes reduced magnetohydrodynamics and the Hasegawa-Mima equation as limiting cases. The single-helicity and axisymmetric versions possess three nonlinear Casimir invariants, from which a generalized potential can be constructed. Variation of the generalized potential yields a description of exact nonlinear stationary states. The new equilibria, allowing for plasma flow as well as partial electron adiabaticity, are distinct from those found in conventional magnetohydrodynamic theory. They differ from electrostatic stationary states in containing plasma current and magnetic field excitation. One class of steady-state solutions is shown to provide a simple electromagnetic generalization of drift-solitary waves.

24903 **(GTFR—53) Trajectories of charged particles traversing a plasma sheath in an oblique magnetic field.** DeWald, A.B.; Bailey, A.W.; Brooks, J.N. (Georgia Inst. of Tech., Atlanta (USA)). Nov 1984. Contract AS05-78ET52025. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011070.

A particle-in-cell technique is used to model a plasma sheath in which the magnetic field intersects the surface at an oblique angle. The angle of impact of deuterium and impurity ions striking the surface is examined and found to depend on the relative sizes of the ion gyroradii and the Debye length.

24904 **(IFUSP-P—362) Measurement of the electron density in a Tokamak by Faraday rotation.** Vuolo, J.H.; Galvao, R.M.O. (Sao Paulo Univ. (Brazil). Inst. de Fisica). Sep 1982. 27p. (LFP—11). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700512.

A method for the measurement of the electron density in a Tokamak by measuring the Faraday rotation in a far-infrared beam propagating in the plasma is described. The propagation direction is considered tangential to a toroidal field line and it is shown that the effect on the polarization of the wave is reduced to pure optical activity related only to the toroidal field and to the electron density. Detailed calculations are presented for the TBR Tokamak at Instituto de Fisica (Sao Paulo University).

24905 **(INIS-BR—156) Plasma heating by kinetic Alfven wave.** Assis, A.S. de. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). 1982. 242p. (In Portuguese). NTIS (US Sales Only), PC A11/MF A01. File Number DE85780829.

The heating of a nonuniform plasma (electron-ion) due to the resonant excitation of the shear Alfven wave in the low β regime is studied using initially the ideal MHD model and posteriorly using the kinetic model. The Vlasov equation for ions and the drift kinetic equation for electrons have been used. Through the ideal MHD model, it is concluded that the energy absorption is due to the continuous spectrum (phase mixing) which the shear Alfven wave has in a nonuniform plasma. An explicit expression for the energy absorption is derived. Through the kinetic model it is concluded that the energy absorption is due to a resonant mode conversion of the incident wave into the kinetic Alfven wave which propagates away from the resonant region. Its electron Landau damping has been observed. There has been a concordance with the MHD calculations.

24906 **(INIS-mf—9503) Development of a low-cost inductively coupled argon plasma.** Ripson, P.A.M. (Technische Hogeschool Delft (Netherlands)). 15 Sep 1983. 83p. NTIS (US Sales Only), PC A05/MF A01. File Number DE85780830.

Includes Dutch summary.

The aim of this investigation is to drastically reduce running costs of an inductively coupled plasma. This is done by reducing the argon consumption from 20 l/min to about 1 l/min. First, a sample introduction system operating on 0.1 l/min of carrier argon is described. This system ensures a high ratio of plasma argon and carrier argon even at the low total argon consumptions intended. Next, the developed low consumption plasma is presented. In the proposed design, air is blown perpendicularly against the outside of the torch. A different coil has been developed to make air-cooling efficient. Preliminary data on coupling efficiency for the air-cooled plasma are presented. A similarly low argon consumption has been achieved with water as an external coolant medium. It is concluded that a cheaper alternative to the current ICP has become available.

24907 **(INIS-mf—9508) Relativistic Boltzmann theory for a plasma.** Erkelens, H. van. (Amsterdam Univ. (Netherlands)). 23 May 1984. 224p. NTIS (US Sales Only), PC A06/MF A01. File Number DE85780831.

Includes Dutch summary.

This thesis gives a self-contained treatment of the relativistic Boltzmann theory for a plasma. Here plasma means any mixture containing electrically charged particles. The relativistic Boltzmann equation is linearized for the case of a plasma. The Chapman-Enskog method is elaborated further for transport phenomena. Linear laws for viscous phenomena are derived. Then the collision term in the Boltzmann theory is dealt with. Using the transport equation, a kinetic theory of wave phenomena is developed and the dissipation of hydromagnetic waves in a relativistic plasma is investigated. In the final chapter, it is demonstrated how the relativistic Boltzmann theory can be applied in cosmology. In doing so, expressions are derived for the electric conductivity of the cosmological plasma in the lepton era, the plasma era and the annihilation era.

24908 (IPPJ—632, pp 18-29) **3-D resistive MHD calculations for tokamak plasmas: beyond the simple reduced set of equations.** Carreras, B.A.; Garcia, L.; Hender, T.C. (Oak Ridge National Lab., TN (USA)); Hicks, H.R.; Holmes, J.A.; Lynch, V.E.; Masden, B.F. Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).

Numerical studies of the resistive stability of tokamak plasmas in cylindrical geometry have been performed using: (1) the full set of resistive Magnetohydrodynamic (MHD) equations and (2) an extended version of the reduced set of resistive MHD equations including diamagnetic and electron temperature effects. In particular, the nonlinear interaction of tearing modes of many helicities has been investigated. The numerical results confirm many of the features uncovered previously using the simple reduced equations.

24909 (IPPJ—632, pp 30-42) **Reduced equations for internal kinks in tokamaks.** Izzo, R.; Monticello, D.A.; Strauss, H.R.; Park, W.; Manickam, J.; Delucia, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).

A reduced set of ideal MHD equations are derived for large aspect ratio, low β tokamaks that adequately describe the linear and nonlinear evolution of ideal internal kink modes in tokamaks.

24910 (IPPJ—632, pp 76-79) **Search for a higher β stellarator.** Betancourt, Octavio (New York Univ., NY (USA)). Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).
Published in summary form only.

24911 (IPPJ—632, pp 80-83) **MHD problems in heliotron plasmas.** Wakatani, M. (Kyoto Univ., Uji (Japan). Plasma Physics Lab.). Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).
Published in summary form only.

24912 (IPPJ—632, pp 84-96) **Equilibrium and stability studies for high beta plasmas in torsatron/heliotron devices.** Carreras, B.A.; Cooper, W.A. (Oak Ridge National Lab., TN (USA)); Charlton, L.A. Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).
The equilibrium and stability properties of high β plasmas in torsatron/heliotron devices have been investigated. Three numerical approaches have been used to study plasma equilibria for a range of coil configurations. The method of averaging permits fast equilibrium and stability calculations. Two fully 3-D codes, namely the Chodura-Schluter code, and the NEAR code recently developed at ORNL, are used to explore selected regions of parameter space. The resulting equilibria calculated with different methods are in good agreement. This validates the average method approach and enhances its usefulness. Results are presented for configurations with different aspect ratios and number of field periods. The role of the vertical field has also been studied in detail. The main conclusion is that for moderate aspect ratios (Asub(p) <= 8), the self-stabilizing effect of the magnetic axis shift is large enough to open a direct path to the second stability regime.

24913 (IPPJ—632, pp 116-121) **Nonlinear tearing in the RFP.** Nebel, R.A.; Caramana, E.J.; Watt, R.G. (Los Alamos National Lab., NM (USA)); Schnack, D.D. Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).
Published in summary form only.

24914 (IPPJ—632, pp 122-127) **Tearing mode of reversed field pinches.** Ashida, H. (Electrotechnical Lab., Sakura, Ibaraki (Japan)); Amano, T.; Nagata, A. Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).
Published in summary form only.

24915 (IPPJ—632, pp 1-17) **MHD computation at JAERI. Extended abstract of MHD computations at JAERI, numerical study of resistive internal kink mode, and finite-beta effect on tearing mode.** Takeda, Tatsuoki; Azumi, Masafumi; Tsunematsu, Toshihide; Kumagai, Michikazu; Kurita, Gen-ichi; Naraoka, Ken-itsu; Takizuka, Tomonori; Tanaka, Yukio; Tokuda, Shinji (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).
The low n MHD modes on the basis of various models have been studied to obtain the comprehensive theoretical understanding of tokamak plasma. The project TRITON has been developed. The main objectives of the project are to analyze the equilibrium with maximum possible beta value and the accessibility to the high beta equilibrium, and to analyze the mechanism of disruptive instability and to find the suppressing and controlling methods. The low n MHD modes are responsible for the major disruption, internal disruption and the beta limit of tokamak plasma. Efficient and accurate equilibrium codes and interface modules were developed. The numerical methods to make the stability calculation efficiently were devised. The applicability of the conventional reduced set of the resistive MHD equations was investigated. The m=1/n=1 resistive internal mode, the finite beta effect of the m=2/n=1 and m=3/n=2 resistive modes, and the finite-n ideal ballooning modes are described.

24916 (IPPJ—632, pp 43-50) **Three-dimensional MHD simulation on the stability of a high-beta tokamak.** Ogino, T. (Nagoya Univ. (Japan). Research Inst. of Atmospherics); Sanuki, H.; Kamimura, T. Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).
The equilibrium configuration of a high-beta tokamak to give the maximum toroidal beta was studied from a two-dimensional MHD simulation under the condition of a constant total toroidal current when the magnitude of a vertical magnetic field was controlled in the equilibrium, which was made by adjusting the diamagnetic effect and the toroidal current profile. The stability of the equilibrium given by the two-dimensional MHD simulation was studied using a three-dimensional MHD simulation for the low-n ballooning mode. The ballooning instability grows in the outside region of a torus, namely in the bad curvature region of magnetic field lines, and is stabilized due to the shorter connection length and wall effect corresponding to the fixed boundary condition.

24917 (IPPJ—632, pp 51-64) **Spheromak tilting and its stability control.** Hayashi, T.; Sato, T. (Hiroshima Univ. (Japan)). Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).
Spheromak tilting instability was studied. A numerical technique to create a rather arbitrarily-shaped spheromak like the one with a flux hole was investigated. The dynamics governing the tilting instability, namely, the influence of the magnetic index, the toroidal current (q-profile) and the resistivity upon the tilting growth rate, and the roles of magnetc reconnection upon the nonlinear development were studied. The best way to control the tilting instability was invented. The stabilizing effects of the vertical wall, the isolated conducting cylindrical belt, and the horizontal wall were studied. Central pole stabilization was also investigated. The influence of the wall condition, namely, whether the wall acted as a flux conserver in the spheromak creation stage or not is discussed. The present study has shown that the three-dimensional simulation is indeed useful and practical in not only studying the underlying physics but also finding a stabilization technique of spheromaks.

24918 (IPPJ—632, pp 65-75) **Three-dimensional spheromak merging.** Oda, Y.; Sato, T. (Hiroshima Univ. (Japan)). Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).
The three-dimensional approach to the spheromak merging process is described. Review is made on the simulation result of axisymmetric spheromak merging. The numerical model is such that two flux cores are installed side by side inside a vacuum vessel. In the axisymmetric merging, calculation was restricted within a half cross section of the vacuum cylinder. Two typical examples are presented. One is the merging of two identical spheromaks, and the other is the merging of two different spheromaks. The temporal changes of the total magnetic energy and the magnetic helicity were examined. The radial q-profiles of the pre- and post-merging spheromak were obtained. The three-dimensional simulation of merging was investigated. In order to see the three-dimensional stability of merging spheromaks, two different perturbation methods were employed. They were a tilting preturbation and a helical kink perturbation. In the present case, the merging of two identical spheromaks is considered. It was observed that the titlting instability developed faster than the approaching speed of two spheromaks, hence, no merging occurred. For a helical kink perturbation, both spheromaks were stable, and approached to each other. Merging was completed, and thereafter, an instability developed. The in-

stability was not a helical kink type instability, but a tilting instability. This fact seems to be consistent with the theoretical conjecture.

24919 (IPPJ—632, pp 97-115) **Nonlinear three-dimensional MHD calculations of resistive instabilities in a reversed field pinch.** Mirin, A.A.; Killeen, J. (Lawrence Livermore National Lab., CA (USA)). Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).

A three-dimensional, finite beta, compressible, nonlinear resistive MHD code, TEMCO, was used to study resistive instability in a reversed field pinch (RFP). The code uses cylindrical coordinates, hence, it is applicable to both cylindrical and toroidal geometries. In the present study, an infinite aspect ration (cylindrical) RFP was assumed. This presentation consists of description on the physics and numrical techniques used for TEMCO along with the illustrative simulation of the evolution and interaction of g modes in RFP. Code simulation was made for the axisymmetric case and the helical mode. The axisymmetric case developed qualitatively similarly to that of Schnack et al. The helical case also agreed qualitatively with that of Schnack et al. An important difference was that Schnack effectively included the higher harmonics of the same helicity. A simultaneous running of both cases was examined. It illustrated the phenomenon of nonlinear mode coupling.

24920 (IPPJ—632, pp 136-144) **3D equilibrium codes for mirror machines.** Kaiser, T.B. (Lawrence Livermore National Lab., CA (USA)). Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).

The codes developed for cumputing three-dimensional guiding center equilibria for quadrupole tandem mirrors are discussed. TEBASCO (Tandem equilibrium and ballooning stability code) is a code developed at LLNL that uses a further expansion of the paraxial equilibrium equation in powers of β (plasma pressure/magnetic pressure). It has been used to guide the design of the TMX-U and MFTF-B experiments at Livermore. Its principal weakness is its perturbative nature, which renders its validity for high-β calculation open to question. In order to compute high-β equilibria, the reduced MHD technique that has been proven useful for determining toroidal equilibria was adapted to the tandem mirror geometry. In this approach, the paraxial expansion of the MHD equations yields a set of coupled nonlinear equations of motion valid for arbitrary β, that are solved as an initial-value problem. Two particular formulations have been implemented in computer codes developed at NYU/Kyoto U and LLNL. They differ primarily in the type of grid, the location of the lateral boundary and the damping techniques employed, and in the method of calculating pressure-balance equilibrium. Discussions on these codes are presented in this paper.

24921 (IPPJ—632) **Proceedings of the US-Japan workshop on 3-D MHD simulation.** (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1983. 153p. (CONF-830342—). NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869.

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).

Separate abstracts for each paper were entered into the data base. (MOW)

24922 (KFTI—83-16) **Mathematical model of particle and energy balance in a tokamak with adiabatic compression and its comparison with the experiment of the Tuman-3 device.** Besedin, N.T.; Kuznetsov, Yu.K.; Pavlichenko, O.S.; Pyatov, V.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700832.

A one-dimensional hybrid transport model is elaborated for a tokamak with adiabatic compression in the framework. The analysis of experimental results is performed and dynamics of ohmic discharge in the Tuman-3 device is studied. The channels of losses at the initial and quasistationary discharge stages are investigated. The role of the neoclassical particle pinch-effect in the formation of plasma density profiles and the impurities influence on the development of saw-tooth oscillations caused by MHD instabilities are pointed out. The threshold nature of ion temperature dependence in the discharge centre on the value of average electron density is shown. For a better understanding of specific features of the model, expressions describing separate physical processes are given.

24923 (KFTI—83-21) **Balloon MHD-modes in toroidal systems with a complex form of magnetic axis.** Demchenko, V.V.; Mikhajlovskij, A.B.; Omel'chenko, A.Ya. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700835.

The stability ideal balloon MHD modes induced by shear in dosed magnetic traps with arbitrary-shaped magnetic axis configurations is analytically investigated. Using the small oscillation method the stability criterion is obtained and investigated. The criterion permits the determining of a maximum pressure of hydromagnetically stable plasma in a broad class of equilibrium toroidal configurations. The criterion obtained is used for analyzing the plasma stability in toroidal traps with magnetic axes representing the simplest closed spatial curves. It is shown that modulation of the magnetic axis curvature deteriorates the plasma stability relative to the swing of ideal balloon modes. In a currentless plasma with positive shear the balloon modes turn to be less dangerous than the Mercier-type disturbances.

24924 (KFTI—83-29) **Nonlinear theory of parametric kinetic instabilities in a plasma.** Mikhajlenko, V.S.; Stepanov, K.N. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1983. 43p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700834.

For parametric kinetic-type instabilities, caused by resonance particle oscillation builup, the weak turbulence theory for a general case of finite particle shifts in a sinusoidal pumping wave field is generalized. Generalization of quasilinear kinetic equations for the case of finite particle shifts is obtained. Based on the generalized theory the nonlinear stage is investigated and the saturation level of the ion cyclotron kinetic parametric instability is determined in case when a relative ion and electron velocity is less than or the order of the ion thermal velocity. Rates of turbulent heating of plasma components are estimated.

24925 (ORNL/TM—9471) **Thomson scattering on ELMO Bumpy Torus.** Cobble, J.A. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 56p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010584.

Below 10^{12} cm^{-3} density, a Thomson scattering experiment is an exacting task. Aside from the low signal level, the core plasma in this instance is bathed in high-energy x rays, surrounded by a glowing molecular surface plasma, and heated steady state by microwaves. This means that the noise level from radiation is high and the environment is extremely harsh-so harsh that much effort is required to overcome system damage. In spite of this, the ELMO Bumpy Torus (EBT) system has proven itself capable of providing reliable n/sub e/ and T/sub e/ measurements at densities as low as 2×10^{11} cm^{-3}. Radial scans across 20 cm of the plasma diameter have been obtained on a routine basis, and the resulting information has been a great help in understanding confinement in the EBT plasma. The bulk electron properties are revealed as flat profiles of n/sub e/ and T/sub e/, with density ranging from 0.5 to 2.0×10^{12} cm^{-3} and temperature decreasing from 100 to 20 eV as pressure in the discharge is increased at constant power. Evidence is presented for a suprathermal tail, which amounts to about 10% of the electron distribution at low pressures. The validity of this conclusion is supported by two independent sensitivity calibrations.

24926 (SAIC—85/1050-PRI-89) **Stability of a hot symmetric tandem mirror with thermal barrier.** Tsang, K.T. (Science Applications International Corp., Boulder, CO (USA). Plasma Research Inst.). Feb 1985. Contract AC03-76ET53057. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010539.

It is shown that in general the stability of a hot electron symmetric tandem mirror is the same as the stability of its barrier-plug cell alone, plus an additional limitation on the center cell length such that the center cell Alfven frequency is higher than the average barrier-plug E x B drift and the hot electron precession frequency. Stability of the hot electron barrier-plug cell is studied extensively.

24927 **(TRITA-EPP—83-08) Improved microwave interferometer technique for plasma density measurements.** Brenning, N. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electron and Plasma Physics). Dec 1983. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85700833.

An improved technique is developed for microwave interferometer measurements of plasma density, where the most useful features of previously described techniques are combined. Phase angles from a few degrees to several times 360 C degrees can be measured without ambiquity, and there are no phase angles with zero phase shift sensitivity. Reductions of the microwave power (e.g. due to absorption in the plasma) with up to a factor 100 can be taken into account in the evaluation of the measurements. With low power in the test beam, a polar display of the test beam phasor is possible. The minimization of errors due to imperfect components, and due to uncertainties in the measured quantities, are investigated theoretically and experimentally. The construction and testing of an interferometer based on this technique is described.

24928 **Steady-state plasma production and fluid flow in ion beams with step-function density profiles.** Lemons, D.S.; Jones, M.E.; Kadish, A.; Lee, H.; Newberger, B.S. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **57**: No. 11, 4962-4967(1 Jun 1985).

The steady-state fluid equations for plasma production and transverse flow in an ion beam with a step-function density profile are solved exactly in both slab and cylindrical geometries. The beam edge is treated as both a neutral and a non-neutral sheath. In the former, the beam density falls from its value inside the beam to zero in a distance much greater than a Debye length, while in the latter the Debye length is much greater than the beam falloff distance. Physical solutions with plasma density profiles which decrease monotonically from the beam center are shown not to exist for negative ion beams with a non-neutral sheath.

24929 **Electron-cyclotron heating of a tokamak reactor at down-shifted frequencies.** Fidone, I.; Giruzzi, G.; Mazzucato, E. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids;* **28**: No. 5, 1224-1226(May 1985). Contract AC02-76CH03073.

The absorption of electron cyclotron waves in a hot, dense tokamak plasma is investigated for the case of the extraordinary mode for outside launching. It is shown that, for electron temperatures T/ sub e/ > or = 5 keV, strong absorption occurs for oblique propagation at frequencies significantly below the electron gyrofrequency at the plasma center. A new density dependence of the wave absorption is found which is more favorable for plasma heating than the familiar n^{-1}/sub e/ scaling.

24930 **Superbanana plateau regime transport in a multiple-helicity torsatron and a bumpy torus.** Hastings, D.E.; Shaing, K.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **28**: No. 5, 1402-1408(May 1985). Contract AC05-84OR21400.

An analytic expression for the neoclassical flux valid in both a multiple-helicity torsatron and a bumpy torus in the superbanana plateau regime is obtained. The expression is valid for arbitrary values of Phi', the radial electric field, partialϵ/sub H//partialr with ϵ/sub H/ the effective helical modulation or bumpiness, and partialϵ/sub T//partialr with ϵ/sub T/ the effective toroidal modulation. When small mirror force terms are included in the flux, a nonlinear first-order ordinary differential equation in Phi' is obtained from the ambipolarity relationship.

24931 **Azimuthal electric fields and ambipolarity in a multiple-helicity torsatron.** Hastings, D.E.; Shaing, K.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **28**: No. 5, 1409-1414(May 1985).

In a torsatron there are multiple solutions to the ambipolarity relationship for the electric field. If the electric field is small over some region of space then the self-consistent poloidal electric field can be important and lead to potential islands. If the plasma is in the superbanana plateau regime, then slow resonant particles limit the rate of change of the electric field and, hence, give a minimum width for the spatial zone where the plasma is changing roots of the ambipolarity relationship.

24932 **Interaction of a rotating relativistic electron beam with a plasma.** Peter, W.; Rostoker, N. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **28**: No. 5, 1532-1537(May 1985).

A one-dimensional model of a rotating electron beam interacting with a plasma in a conducting drift tube is presented. A constant magnetic field is assumed to exist in the axial direction. Magnetohydrodynamic-like equations describing the plasma response to the external beam current are justified and solved analytically in cyclindrical geometry. The results are compared with numerical results and actual experimental magnetic probe traces. For a long-pulse beam (T>>2π/Ω/sub i/), the energy lost by the beam is calculated to be $W = (2\pi a I_0/c)^2 (1-a^2/R^2)$, where a is the beam radius, R is the radius of the conducting wall, and I_0 is the current per unit length of the beam.

24933 **Generalized gyrokinetics.** Bernstein, I.B.; Catto, P.J. (Section of Applied Physics, Yale University, New Haven, Connecticut 06520). *Physics of Fluids;* **28**: No. 5, 1342-1353(May 1985). Contract AC02-77ET53053.

A nonlinear gyrokinetic formalism is developed which admits mean velocities comparable to thermal speeds in arbitrary magnetic field geometry. The theory is fully electromagnetic and does not employ an eikonal ansatz. The moments of the gyrokinetic distribution function, as well as the gyrokinetic equation it satisfies, are derived to first order in the guiding center expansion parameter. This large mean velocity formulation is important whenever the E x B drift over the thermal speed cannot be ordered small. For example, upon summing over all species, the moment description yields a set of generalized magnetohydrodynamic equations which are valid to one order higher in the expansion parameter.

24934 **Optimized Fourier representations for three-dimensional magnetic surfaces.** Hirshman, S.P.; Meier, H.K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **28**: No. 5, 1387-1391(May 1985). Contract AC05-84ER21400.

The selection of an optimal parametric angle θ describing a closed magnetic flux surface is considered with regard to accelerating the convergence rate of the Fourier series for the Cartesian coordinates x(θ,phi)equivalentR-R_0 and y(θ,phi)equivalentZ-Z_0. A system of algebraic equations, which are quadratic in the Fourier amplitudes of x and y, is derived by minimizing the width of the surface power spectrum. The solution of these nonlinear equations, together with the prescribed surface geometry, determines a unique optimal angle. A variational principle is used to solve these constraint equations numerically. Application to the representation of three-dimensional magnetic flux surfaces is considered.

24935 **Experimental control of the spheromak tilting instability.** Munson, C.; Janos, A.; Wysocki, F.; Yamada, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids;* **28**: No. 5, 1525-1527(May 1985). Contract AC02-76CH03073.

The magnetohydrodynamic (MHD) tilting instability of the spheromak configuration has been experimentally investigated by recording the time evolution of the magnetic field with small magnetic probes. Passive coil systems such as the figure-eight and saddle coils have been proven experimentally effective against this instability.

24936 **Theory of dissipative density-gradient-driven turbulence in the tokamak edge.** Terry, P.W.; Diamond, P.H. (Institute for Fusion Studies, University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **28**: No. 5, 1419-1439(May 1985). Contract FG05-80ET53088.

A theory of resistive, density-gradient-driven turbulence is presented and compared with tokamak edge fluctuation measurements. In addition to linear driving, the theory accounts for relaxation of the density gradient through a nonlinear process associated with emission from localized density fluctuation elements. From a fluid model for isothermal electrons in toroidal geometry, equations are obtained and solved analytically, retaining both coherent and incoherent contributions. The effect of collisions on the density blobs is treated. A Reynolds number parameterizes the magnitude of the turbulent scattering relative to the collisional viscous diffusion. The analytic results indicate that the spectrum is characterized by linewidths which increase as a function of the Reynolds number and may reach $\Delta\omega/\omega >$ or $\simeq 1$. Energy lies predominantly in the small wavenumbers (k/sub perpendicular/ rho/sub s/$\sim$0.1). For larger wavenumbers and frequency, the spectrum decays as k/sup -17/6/ and ω^{-2}. The fluctuation level scales as 1/k/sub perpendicular/L/sub n/ and may reach -30% for parameters typical of the pretext edge. Particle diffusion is Bohm-like in magnitude but does not follow Bohm scaling, going instead as n^2/sup //^{3}T/sup 1/6// sub e/. The density fluctuations exhibit nonadiabatic character caused by the incoherent mode coupling. An expression for the departure from adiabaticity is given.

24937 **Spatial imaging in the soft x-ray region (20—304 A) utilizing the astigmatism of a grazing incidence concave grating.** Nudelfuden, A.; Solanki, R.; Moos, H.W. (Johns Hopkins University, Physics Department, Baltimore, Maryland 21218). *Applied Optics;* **24**: No. 6, 789-792(15 Mar 1985).

Soft x-ray (20—304—A) astigmatic line shapes were measured in order to evaluate the spatial imaging properties of a Rowland mounted concave grating in grazing incidence. The practicability of coarse 1-D spatial imaging in the soft x-ray region is demonstrated. Spatial resolution equivalent to $\sim$4 cm at a source distance of 2 m can be achieved with practical parameters (e.g., sensitivity and time resolution) for a fusion diagnostic spectrograph. The results are compared to computer-generated ray tracings and found to be in good agreement. The ray tracing program which models the grazing incidence optics is discussed.

24938 **Geonium lineshape.** Brown, L.S. (Department of Physics, FM-15, University of Washington, Seattle, Washington 98195). *Annals of Physics (New York);* **159**: No. 1, 62-98(Jan 1985). Contract AC06-81ER40048.

The most precise determination of the magnetic moments of the electron and positron come from the University of Washington Geonium experiments. Present improvements in the accuracy of these experiments now require that the detailed shapes of the lines which they detect must be know to extract the moments with a corresponding precision. The linewidths arise because the trapped particle oscillates in a magnetic field which is made slightly inhomogeneous so that it varies quadratically with the oscillator displacement. The oscillaator undergoes a random, thermal, Brownian motion. Thus the lineshapes are related to a nonlinear noise problem. This problem is solved by writing the stochastic average of the oscillator motion as a functional integral which transcribes it into an easily solved one-dimensional, quantum-mechanical barrier penetration problem. Although this paper concentrates on a particular experiment, the techniques developed here should be useful in a wide variety of problems.

24939 **Motion of a charged particle in slowly varying electromagnetic fields.** Weitzner, H. *Communications on Pure and Applied Mathematics;* **36**: 695-704(1983). Contract AC02-76ER03077.

The formulation of the problem of motion of a single particle in slowly varying electromagnetic fields is discussed. An appropriate guiding center model is constructed and single-particle confinement is examined.

24940 **Long-time states of inverse cascades in the presence of a maximum length scale.** Hossain, M.; Matthaeus, W.H.; Montgomery, D. (Coll. of William and Mary, Williamsburg, VA). *Journal of Plasma Physics;* **30**: 479-493(1983).

It is shown numerically, both for the two-dimensional Navier-Stokes (guiding centre plasma) equations and for two-dimensional magnetohydrodynamics, that the long-term asymptotic state in a forced inverse-cascade situation is one in which the spectrum is completely dominated by its own fundamental. The growth continues until the fundamental is dissipatively limited by its own dissipation rate.

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REFER ALSO TO CITATION(S) 23589, 23875, 24006, 24009, 24010, 24011, 24012, 24013, 24014, 24015, 24016, 24017, 24018, 24019, 24020, 24021, 24055, 24233

24941 **(ANL/FPP/TM—200) Effects of Formvar coating and copper-nickel outer sheath on the ac losses of multistrand subsize cables.** Kim, S.H. (Argonne National Lab., IL (USA)). Feb 1985. Contract W-31-109-ENG-38. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010413.

Ac losses of two subcables, one with Formvar coating on the strands of the BNL 12-ml NbTi/Cu/CuNi conductor and another without the coating, were measured using the ANL Subcable Test Facility. The results indicate that couplings among the strands with and without the Formvar coating were quite weak. Weak coupling of the bare strands is due to the high resistance of the copper-nickel outer sheath. In the regime of B(dot) = 0 $\sim$ 1.2 T/s and B = 0 $\sim$ 4 T, the magnetic diffusion time constant was (3.8 - 5.7) x 10^{-3} s.

24942 **(CONF-790622—) 2nd IEEE international pulsed power conference. Digest of technical papers.** Guenther, A.H.; Kristiansen, M. (eds.). (Texas Tech Univ., Lubbock (USA). Dept. of Electrical Engineering; Air Force Weapons Lab., Kirtland AFB, NM (USA)). 1979. Contract FG05-79ET52051. 522p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Separate abstracts were prepared for 75 of the included papers. Twenty-six of the remaining papers appeared previously in ERA. (MOW)

24943 (CONF-790622—, pp 9-16) **Pulsed high-current electron technology.** Mesyats, G.A. (Academy of Sciences, Tomsk, USSR). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The use of high-power pulse technology and explosive electron emission enables one to construct new pulsed electron devices. The present report gives the results of an intensive investigation of high-power pulse generation, electron beam geometry and the application of these beams to the production of ultra high frequency, laser and x-ray radiation. This report is based on results obtained at the Institute of High-Current Electronics.

24944 (CONF-790622—, pp 17-24) **New hydrogen thyratrons for advanced high power switching.** Turnquist, D.; Caristi, R.; Friedman, S.; Merz, S.; Plante, R. (EG & G Inc., Salem, MA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Recent advances in high power switching have led to the development of new hydrogen thyratrons operating at high prr and high di/dt with low jitter and long life. Short commutation times, dependent on internal pressure and geometry and on the method of triggering, combine with inductance less than 1/4 nh/kV to give di/dt on the order of 10^{12} amperes per second. Experimental results are in agreement with those predicted by newly derived theoretical models. Operation at peak currents up to 75 ka has been achieved for 10 μs pulses, and much higher currents can be achieved at shorter pulse widths. Tests at 1 MW of average power have verified thyratron scaling laws at tens of amperes average and kiloamperes rms. Thyratron operation at average power levels far in excess of 1 MW is possible.

24945 (CONF-790622—, pp 25-30) **Accelerator module of "Angara-5".** Basenkov, S.V.; Gusev, O.A.; Istomin, Ju.A.; Koba, Ju.V.; Latmanizova, G.M.; Pasechnikov, A.M.; Pevchev, B.P.; Pecherskii, O.P.; Perlin, A.S.; Rudakov, L.I. (Inst. of Atomic Energy, Moscow, USSR). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Features and design principles of the inertial confinement fusion multi-module Angara-5 accelerator are considered. The computed output parameters of an individual module are as follows: U = 2 MeV; I = 0.8 MA T/sub 1/2/ = 90 ns; W = 102 kJ. The predicted output was compared with the pulse-shaping line mock-up measurements. According to these measurements the end-on section contributes 21% of the total pulse-shaping line capacitance. The end-on section capacitance was accounted for in computations via transmission line sections with appropriate impedance values. The reasonable choice of the pulse-shaping equivalent circuit was confirmed by experimental data which were in good agreement with calculations based on system design features.

24946 (CONF-790622—, pp 42-48) **Electromagnetic guns, launchers and reaction engines.** Kolm, H.; Fine, K.; Williams, F.; Mongeau, P. (Massachusetts Inst. of Tech., Cambridge). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Recent advances in energy storage, switching and magnet technology make alectromagnetic acceleration a viable alternative to chemical propulsion for certain tasks, and a means to perform other tasks not previously feasible. Launchers of interest include the dc railgun driven by energy stored inertially in a homopolar generator and transferred through a switching inductor, and the opposite extreme, the synchronous mass driver energized by a high voltage alternator through an oscillating coil-capacitor circuit. A number of hybrid variants between these two extremes are also promising. A novel system described here is the momentum transformer which transfers momentum from a massive chemically driven armature to a much lighter, higher velocity projectile by magnetic flux compression. Potential applications include the acceleration of gram-size particles for hypervelocity research and for use as reaction engines in space transport; high velocity artillery; stretcher-size tactical supply and medical evaluation vehicles; the launching of space cargo or nuclear waste in one-ton packets using off-peak electric power.

24947 (CONF-790622—, pp 49-54) **Near and long term pulse power requirement for laser driven inertial confinement fusion.** Gagnon, W.L. (Lawrence Livermore Lab., CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613. Contract W-7405-ENG-48.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Inertial confinement fusion research is being vigorously pursued at the Lawrence Livermore Laboratory and at other laboratories throughout the world. At the Lawrence Livermore Laboratory, major emphasis has been placed upon the development of large, Nd:glass laser systems in order to address the basic physics issues associated with light driven fusion targets. A parallel program is directed toward the development of lasers which exhibit higher efficiencies and shorter wavelengths and are thus more suitable as drivers for fusion power plants. This paper discusses the pulse power technology which has been developed to meet the near and far term needs of the laser fusion program at Livermore.

24948 (CONF-790622—, pp 55-64) **Self-magnetically insulated power flow.** VanDevender, J.P. (Sandia Labs., Albuquerque, NM). 1979. NTIS, PC A22/MF A01. File Number DE85000613. Contract AC04-76DP00789.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Electromagnetic power transport through self-magnetically insulated vacuum transmission lines has been developed into a useful and reliable technology. A power density of 160 TW/m^2 has been transported at ~ 100% efficiency over six meters. The theoretical understanding of power flow through lines of constant cross section has progressed through analytical theory and 2-D electromagnetic particle simulations. However, work needs to be done on the effects of line transitions in which the cross section changes in the direction of power flow. The major features of our present understanding will be reviewed and some promising hypotheses now under investigation will be presented.

24949 (CONF-790622—, pp 65-67) **Voltage distribution and current in a cylindrical relativistic diode.** Harris, N.W. (Ion Physics Co., Burlington, MA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The voltage distribution and current in a space charge limited cylindrical diode are calculated by means of a simple computer program. Relativistic formulation is used, and the results are applicable up to the limit of significant beam pinch. The accuracy is 0.1%.

24950 (CONF-790622—, pp 72-74) **Ion beam generation through a moving plasma boundary.** Dembinski, M.; John, P.K. (Univ. of Western Ontario, London). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

It is shown that ion currents extracted from a moving plasma can be increased by a factor of ~ v/c/sub s/ (v-plasma flow velocity, c/sub s/-ion acoustic speed) as compared with a stationary plasma of the same density and temperature. A conical θ-pinch gun is used to accelerate plasma with density n ~ 10^{12} cm^{-3} to velocity v ~ 10^7 cm/s. Total currents ~ 100 A of 10 to 20 keV ions were obtained from an 8 cm diameter extraction system.

24951 (CONF-790622—, pp 76-82) **Fundamental limitations and design considerations for compensated pulsed alternators.** Weldon, W.F.; Bird, W.L.; Driga, M.D.; Tolk, K.M.; Rylander, H.G.; Woodson, H.H. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613. Contract AS05-77ET52029.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Since the beginning of a project intended to demonstrate the feasibility of using a compensated pulsed alternator (compulsator) as a power supply for NOVA and other solid state laser systems, a great deal of interest has been generated in applying this type of machine to supply energy for other types of loads. This paper outlines the fundamental limitations imposed on the design of such a machine by the mechanical, thermal, magnetic, and electrical properties of the materials used. Using these limitations, the power and energy available from the machine are calculated as functions of machine dimensions. Several configurations for the machine and their relative merits for various applications are also discussed.

24952 (CONF-790622—, pp 83-86) **Use of transformers in producing high power output from homopolar generators.** Lupton, W.H.; Ford, R.D.; Conte, D.; Lindstrom, H.B.; Vitkovitsky, I.M. (Naval Research Lab., Washington, DC). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Analysis is presented for systems using high current pulse transformers to exploit the high energy storage capability of homopolar generators or other limited current sources. The stepped-up secondary current can be established either by current interruption when the primary is also used for energy storage or by commutation of current into the primary from a separate storage inductor. For high-power pulse generators the primary insulation and power supply are protected by subsequent crowbarring of the primary. An example is given of a design for matching the NRL homopolar generator with 1.46 mH inductor to a 1-μH, megavolt level inductive pulse generator.

24953 (CONF-790622—, pp 91-94) **Pulse sharpening in ferrite transmission lines.** Weiner, M. (Electronics Tech. and Devices Lab., Fort Monmouth, NJ). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Pulse sharpening effects in ferrite transmission lines may be used to obtain kV pulses with ns risetime. The exact description of the sharpening effect requires complex shock wave analysis. In this paper an approximate but useful physical model is discussed. The ferrite is treated as a lossy but linear transmission line from which equivalent design results are obtained. In many instances the nonlinear effects present are confined to a region which is small compared to the total transmission length, which makes the linear approximation more plausible. Preliminary experimental results, based on a 130 cm long line, are in accord with the predictions of the model.

24954 (CONF-790622—, pp 96-99) **High power pulse modeling of coaxial transmission lines.** O'Loughlin, J.P. (Air Force Weapons Lab., Kirtland AFB, Albuquerque, NM). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

When coaxial cable is used for high voltage pulse transmission, a voltage transient appears on the outer sheath conductor. Although the magnitude of the transient is in the order of only a few percent, this amounts to several kilovolts in many cases and must be carefully considered in terms of its effect on instrumentation, control and safety. To a first approximation, theoretically a coaxial cable should not develop any voltage on the outer sheath. A more refined analysis and model shows that the complete cancellation depends upon the self inductance of the sheath being exactly equal to the mutual inductance between the sheath and the center conductor. This condition is never exactly satisfied due to current distribution effects, even when the distribution is uniform and radially symmetric. The situation becomes worse when proximity effects are accounted for. The predicted sheath voltage agrees with experimental data within reasonable limits.

24955 (CONF-790622—, pp 100-101) **Light activated 10 kV low jitter pulser.** Galbraith, J.D. (Los Alamos Scientific Lab., NM). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

An optically activated 10 kV pulser was designed to provide low jitter, long life, reliable triggering of ignitrons, trigatron, or midplane triggered spark gaps in high voltage electrically noisy environments. For midplane triggered spark gaps, a step-up transformer is also required. The input to a fibre optic cable is a 9.5 watt injection laser diode. The pulser detects and amplifies the fibre optic cable output to 10 kV.

24956 (CONF-790622—, pp 102-105) **Command charge using saturable inductors.** Black, S.; Burkes, T.R. (Texas Tech Univ., Lubbock). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Line-type pulsers operating at rep-rates greater than a few kilohertz require special circuits to insure proper operation of the switch. Specifically, thyratrons and other closing switches require a grace period of several microseconds or more before anode voltage is reapplied; this delay allows recovery and prevents reclosure of the thyratron. One method of achieving the required delay time is by using a slightly mismatched PFN and slower-than-resonant charging. However, repetition rates of line-type modulators are limited by the characteristics of resonant charging. In order to increase rep-rates, these characteristics may be modified by using a saturable reactor as a charging inductor. This paper describes design considerations and laboratory performance of saturable inductors used to resonately charge an energy storage network up to 25 kV with a delay as much as 16.5 microseconds.

24957 (CONF-790622—, pp 106-113) **Investigations of fast insulator surface flashover.** Thompson, J.E.; Lin, J.; Mikkelson, K.; Kristiansen, M. (Univ. of South Carolina, Columbia; Texas Tech Univ., Lubbock). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Electro-optical measurements of the electric fields along insulator surfaces have been made to determine the mechanisms associated with fast insulator flashover. Data will be presented that show the temporal and spatial performance of the surface fields prior to and at flashover for insulator surfaces oriented at 0° and 45° with respect to the applied field. Results show that the surface field near the cathode is enhanced and the field near the anode is reduced during the excitation. The results further show a temporal reduction in the field non-uniformity as flashover is approached. The field collapse associated with flashover occurs very rapidly for 0° surfaces. The field collapse for 45° surfaces begins at the anode and propagates at 0.83 cm/ns towards the cathode. Mechanisms consistent with these experimental measurements will be postulated.

24958 (CONF-790622—, pp 114-118) **Breakdown in small, flowing gas spark gaps.** Cary, W.K. Jr.; Lindberg, D.D.; Rice, J.W. (Naval Surface Weapons Center, Dahlgren, VA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

An improved method for studying electrical breakdown in small, flowing gas spark gaps is described. The apparatus and data processing yield the time to breakdown, current, resistance, power dissipation and energy loss in the spark gap during the 4 nS in which the current rises from zero to a near constant value. A specially constructed transmission line terminated in a spark gap and instrumented with a B probe and sampling oscilloscope is used to observe the breakdown. The initial charge on the transmission line and the current, obtained by integrating the B signal, provide the information needed to define the spark gap operation in a well characterized coaxial arrangement. With a temporal resolution better than 50 pS, current components with frequencies to 10 GHz could be measured. An electronic circuit held the gap breakdown voltage and the subsequent charge in the transmission line to precise, predetermined values. A computer based data reduction system determined the current waveform from data corrected for the frequency response of the signal delay line. Results are given for argon and nitrogen, each at two overvoltages.

24959 (CONF-790622—, pp 119-121) **Electron densities in laser-triggered spark gap discharges.** Crumley, R.J.; Williams, P.F.; Gundersen, M.A.; Watson, A. (Texas Tech Univ., Lubbock). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The results of experiments designed to measure electron densities from measurements of Stark broadened spectral profiles in laser-triggered discharges in hydrogen are reported. Temporally and spatially resolved data have been obtained both during and after the arc for discharges in hydrogen. Evidence of a shockwave is presented, consistent with the observations of other investigators.

24960 (CONF-790622—, pp 122-126) **Electrical breakdown in water in the microsecond regime.** Fenneman, D.B.; Gripshover, R.J. (Naval Surface Weapons Center, Dahlgren, VA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

This paper describes the research on electrical breakdown in water currently being pursued at NSWC/DL. The experimental apparatus is described in some detail. Results of over 500 tests are presented. Breakdown events were observed predominantly in the 2 to 10 microsecond time domain for applied electrical fields in the range 200 to 500 kV/cm. The wide scatter of the breakdown time which is intrinsic to the phenomena requires a careful examination of the statistics of the data.

24961 (CONF-790622—, pp 127-131) **Pulsed electron field emission from prepared conductors.** Frazier, G.B. (Physics International Co., San Leandro, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The electron emission characteristics of metal cathodes subjected to pulsed electric fields in the absence of insulating magnetic fields has been investigated experimentally. Uniform electric fields in the range of 0.2 to 0.8 MV/cm were applied to 50 cm^2 surfaces under vacuum in single pulses of ~ 60 ns duration at a voltage of ~ 0.5 MV. Bare metals and metals coated with dielectric materials were studied. Results show that bare metals with freshly prepared surfaces can withstand fields of ≃ but > 300 kV/cm for ≃ but > 40 ns without significant emission. Emission-induced discharges degrade the surfaces such that full space-charge-limited current densities (100 to 250 A/cm^2 for this experiment) are obtained at fields as low as 200 kV/cm on subsequent pulses. In the case of coated surfaces, it was found that dielectrics could occasionally suppress emission completely up to ~ 300 to 400 kV/cm, and unlike bare metals, could partially suppress emission after having passed significant current at fields up to 0.6 MV/cm.

24962 (CONF-790622—, pp 148) **Design of solenoids for generating high magnetic fields.** Byszewski, P. (Institute of Physics, Warsaw, Poland). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Magnetic fields of high intensity are usually generated by the pulsed discharge of capacitor banks through solenoids. In order to generate the highest fields, exploding coils or field compression techniques are used. However, for experiments it is essential that the coil withstand the electrodynamical forces. This is achieved by employing coils in which the stress exerted by the current density and the magnetic field does not exceed the strength of the material used to build the coil. The details of stress calculations and current distribution in large solenoids are presented in the paper. Also presented are the details of experiments on the durability of solenoids in external magnetic field. The experiments and calulations are used to build a coil producing a high magnetic field.

24963 (CONF-790622—, pp 149-152) **Analysis of a distributed pulse power system using a circuit analysis code.** Hoeft, L.O. (Air Force Weapons Lab., Kirtland AFB, Albuquerque, NM; BDM Corp., Albuquerque, NM). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A sophisticated computer code (SCEPTRE), used to analyze electronic circuits, was used to evaluate the performance of a large flash x-ray machine. This device was considered to be a transmission line whose impedance varied with position. This distributed system was modeled by lumped parameter sections with time constants of 1 ns. The model was used to interpret voltage, current, and radiation measurements in terms of diode performance. The effects of tube impedance, diode model, switch behavior, and potential geometric modifications were determined. The principal conclusions were that, since radiation output depends strongly on voltage, diode impedance was much more important than the other parameters, and the charge voltage must be accurately known.

24964 (CONF-790622—, pp 157-160) **Versatile high energy capacitor discharge system.** Martin, V.N. (GTE Labs., Inc., Waltham, MA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The requirements for generating half sine waves of current having amplitudes over a range of 36 kA at voltages up to 1.6 kV are being met through the development of a compact, critically damped LCR discharge system containing 0.75F capacitance, which can store up to 60,000J of energy. The system comprises five cartmounted, electrically isolated capacitor banks, each containing 0.15F capacitance and chargeable to a nominal value of 400V, which is controlled by a multielement SCR switch and can be discharged through inductors and resistors to provide one-half of a 60-cycle sinusoid at peak current values up to 36,000A. Circuit designs are presented for the isolation and status indication of each of the 500 capacitors, for inverse diodes to protect the polarized capacitors from reverse recovery voltage experiments performed after the main capacitor bank discharge, and for protection of the capacitors from overvoltage conditions.

24965 (CONF-790622—, pp 161-164) **130 kV low impedance multiple output trigger generator.** Bushnell, A.H.; Dobbie, C.B.; Krickhuhn, A.P. (Maxwell Labs., Inc., San Diego, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A unique low impedance trigger generator has been developed which can generate 130 kV pulses having 22 ns risetime in four 50 ohm output cables. This generator uses a multichannel railgap switch to discharge a group of low inductance capacitors which are charged to 150 kV into the output cables. The performance of the circuit was analyzed using a computer and successfully predicted the behavior of the circuit. Time jitter between input trigger and output pulse is less than 2 ns (one standard deviation). The unit is immersed in oil and its own metal housing.

24966 (CONF-790622—, pp 165-171) **Low-impedance, coaxial-type Marx generator with a quasi-rectangular output waveform.** Obara, M.; Sakato, Y.; Lee, C.H.; Hashimoto, T.; Fujioka, T. (Keio Univ., Yokohama-shi, Japan). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Theoretical analysis of a low-impedance, coaxial type Marx generator, in terms of the equivalent electrical circuit, can offer the most appropriate parameters for the design of a Marx generator to produce a quasi-rectangular output waveform. The results of this theoretical analysis can be extensively applied to the design of various types of coaxial Marx generator. Based upon theoretical analysis, three Marx generators of 0.6 MV, 1.0 MV, and 2.6 MV have been developed for the e-beam initiation of an HF chemical laser. The results of the analysis were in good agreement with the experimental results. They have a completely coaxial configuration. One advantage of these machines is that they can directly drive a low-impedance electron-beam diode, without a low-impedance PFN, for the efficient production of an intense relativistic electron beam. They are also remarkably compact.

24967 (CONF-790622—, pp 172-178) **Design approach to a high-voltage burst generator.** Cummings, D.; Hammon, H.G. III. (Physics International Co., San Leandro, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

An increasing number of experimental programs call for a sequence of several closely spaced, high-voltage pulses. This paper presents the various design considerations for such a system. These include the kind of pulse generator, series or parallel configuration, kinds of lines, aspect ratio, choice of dielectric, switch type, triggering considerations, Marx Generator design and isolation, feed problems, pulse formation, and waveform degradation with increasing stages. The design procedure is illustrated by the M-2 pulser built for the PHERMEX Facility at the Los Alamos Scientific Laboratory. This system produces a train of up to three 40 ns pulses, variable from 600 kV to 1.4 MV with pulse separations of 100 ns to 1 ms. Results are given and waveforms presented.

24968 (CONF-790622—, pp 179-183) **High-pressure surface spark gaps.** Sarjeant, W.J.; Alcock, A.J.; Leopold, K.E. (National Research Council of Canada, Ottawa, Ontario). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The behavior of surface discharge switches at high pressures operating into laser and resistive loads has been studied. The experiments utilized the spark gap as a transfer switch between a pulse-charged ethylene glycol transmission line, (30 ns, 1.4 Ω) and a 17-Ω low-inductance load resistor, as well as a multiatmosphere

rare-gas halide laser. The behavior of the spark gap breakdown voltage and number of channels upon charging voltage and gas pressure in the spark gap was studied in detail. The spark gap operation under laser and resistive load conditions will be compared and related to a first-order model of the gap breakdown. Scalability to higher voltages will be discussed in the context of this model.

24969 (CONF-790622—, pp 184-186) **Parallel combinations of pre-ionized low jitter spark gaps.** Fitzsimmons, W.A.; Rosocha, L.A. (National Research Group, Inc., Madison, WI). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The properties of 10 to 30 kV four electrode field emission pre-ionized triggered spark gaps have been studied. A mid-plane off-axis trigger electrode is biased at $+V_0/2$, and a field emission point is located adjacent to and biased at the grounded cathode potential. Simultaneous application of a $-V_0$ trigger rapid pulse to both the electrodes results in the rapid sequential closing of the anode-trigger and trigger-cathode gaps. The observed jitter is about 1.5 ns. Parallel operation of these gaps (up to 10 so far) connected to a common capacitive load has been studied. A simple theory that predicts the number of gaps that may be expected to operate in parallel is discussed.

24970 (CONF-790622—, pp 187-190) **Streamer model for high voltage water switches.** Sazama, F.J.; Kenyon, V.L. III. (Naval Surface Weapons Center, Silver Spring, MD). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

An electrical switch model for high voltage water switches has been developed which predicts streamer-switching effects that correlate well with water-switch data from Casino over the past four years and with switch data from recent Aurora/AMP experiments. Preclosure rounding and postclosure resistive damping of pulseforming line voltage waveforms are explained in terms of spatially-extensive, capacitive-coupling of the conducting streamers as they propagate across the gap and in terms of time-dependent streamer resistance and inductance. The arc resistance of the Casino water switch and of a gas switch under test on Casino was determined by computer fit to be 0.5 +- 0.1 ohms and 0.3 +- 0.06 ohms respectively, during the time of peak current in the power pulse. Energy lost in the water switch during the first pulse is 18% of that stored in the pulseforming line while similar energy lost in the gas switch is 11%. The model is described, computer transient analyses are compared with observed water and gas switch data and the results - switch resistance, inductance and energy loss during the primary power pulse - are presented.

24971 (CONF-790622—, pp 195-197) **Contacts for pulsed high current; design and test.** Wildi, P. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The TEXT Tokamak required the development of a special contact for pulsed high currents for the split coils of the poloidal system at a location which is highly inaccessible. A solution was found in the form of a special plug contact. A prototype was tested to the failure point using the discharge of a homopolar machine. Design, test setup and test results are described and the results are evaluated in view of other uses such as larger contacts and switches.

24972 (CONF-790622—, pp 202-204) **Development of high current electron pulse accelerators at the Institute of High Temperatures.** Abramyan, E.A.; Kuleshov, G.D. (Academy of Sciences, Moscow, USSR). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A short analysis of the problems encountered in the acceleration of long (10^{-4} sec and longer) pulsed, relativistic electron beams (REB) is given. A description of the parameters of the experimental facilities developed to study these long-pulsed beams is presented.

24973 (CONF-790622—, pp 205-206) **Status of the upgraded version of the NRL GAMBLE II pulse power generator.** Boller, J.R.; Burton, J.K.; Shipman, J.D. Jr. (Naval Research Lab., Washington, DC). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The GAMBLE II water dielectric pulse power generator, in 1970, was the forerunner of the high energy (> 50 kJ) class of water dielectric generators. It has been redesigned internally to make maximum use of its original outer conductor shell and to optimize it for the positive polarity mode of operation for positive ion beam experimentation. The new design also initiates the use of an oil dielectric multi-channel switch at the output of the pulse forming line. This switch, because of its low capacitance, eliminates the need for an extra prepulse switch. The upgraded version has been tested up to power and energy levels which are nearly twice the original.

24974 (CONF-790622—, pp 214-216) **Development of a repetitively pulsed electron beam system.** Tripoli, G.A. (Ion Physics Co., Burlington, MA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A pulsed electron beam system - PEBS-III - has been developed at Ion Physics Company to generate an electron beam of 200 keV, 4 A/cm², 2.5 cm x 75 cm, 1.3 μsec, at high repetition rates. That system incorporates a gas-insulated PFN Marx generator in Guillemin C network configuration to drive a cold-cathode electron gun. System performance corresponded to computer simulation of VI waveformms versus generator-parameter and impedance-collapse variations. The effort demonstrated the usability of a PFN for energization of long-pulse repetitively pulsed electron guns.

24975 (CONF-790622—, pp 217-220) **Development of high repetition-rate pulsed power generators.** Sojka, R.J.; Simcox, G.K. (Physics International Co., San Leandro, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The design and development of high repetition-rate, (> 1 kHz) pulsed power generators are discussed and a set of chosen design approaches presented. The ensuing technical approaches for the pulse forming network, PFN switching, and PFN charging modulators are described. Key elements of the system are the deionized-water, fast-energy store, and a flowing air spark gap switch, both capable of operation at higher than a 1 kHz repetition frequency. Based on this design and development effort, the technical issues of high repetition rate pulsed power systems are discussed, and recommendations are offered for further study and development of dielectrics, spark gap switches, and high power modulators.

24976 (CONF-790622—, pp 221-225) **Frozen-wave Hertzian generators: theory and applications.** Forcier, M.L.; Rose, M.F.; Rinehart, L.F.; Gripshover, R.J. (Naval Surface Weapons Center, Dahlgren, VA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Frozen Wave Hertzian generators have been built which can produce multikilowatt RF pulses in the megahertz frequency range with repetition rates of 10's of kilohertz. These generators do not have a damped sinusoidal output; they generate a discrete, controllable number of rectangular half cycles. The output waveform can be discretely changed from one half-cycle to the next. At the higher frequencies, discontinuities in the switch and dispersion in the cables round the edges of the rectangular half cycles, causing the output waveform to be nearly sinusoidal. These generators have also been used as video pulsers with variable pulse duration and in-

terpulse spacing. Frequency, power and pulse width limitations will be discussed.

24977 (CONF-790622—, pp 226-231) **500 kV rep-rate Marx generator.** Shannon, J. (Maxwell Labs., Inc., San Diego, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

An efficient PFN/Marx generator was constructed for generating high average power electron beams. The generator consists of ten 100 kV PFN stages connected in a Marx configuration. The Marx generator employs purged gas switches. This paper discusses the Marx charging power conditioning and the operation of the generator into resistive and electron beam loads.

24978 (CONF-790622—, pp 237-241) **Effects of surrounding medium on the performance of exploding aluminum foil fuses.** Berger, T.L. (Naval Surface Weapons Center, Dahlgren, VA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Flat aluminum foil fuses were exploded electrically by discharging a capacitor bank into a series combination inductance (~ 600 nH) and fuse. The 2.54 x 2.54 x 0.0023 cm foils were exploded in a sealed chamber. The time to burst and fuse voltage characteristics were investigated as a function of the fuse environment. Results are given for foils exploded in various gases and liquids.

24979 (CONF-790622—, pp 242-245) **High power very long pulse testing of a 200 kV tetrode regulation tube.** Stabley, J.D.; Gray, B. (RCA, Lancaster, PA; Rome Air Development Center, Griffiss AFB, NY). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Tests at very long pulse lengths were conducted to evaluate the design concepts of the S94000E regulator tube at the Rome Air Development Center. Voltages as high as 200 kV have been switched for pulse lengths of 0.5 seconds and at anode dissipation levels that exceeded 2.0 million watts. Tubes similar to the one tested will be employed as series regulators at the TOKAMAK Fusion Test Reactor. This paper discusses the tube, test results, and operational experiences associated with those tests.

24980 (CONF-790622—, pp 246-249) **Very fast, high peak power planar triode amplifiers for driving optical gates.** Howland, M.M.; Davis, S.J.; Gagnon, W.L. (Lawrence Livermore Lab., CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Recent extensions of the peak power capabilities of planar triodes have made possible the latter's use as very fast pulse amplifiers, to drive optical gates within high-power Nd:glass laser chains. These pulse amplifiers switch voltages in the 20 kV range with rise times of a few nanoseconds, into crystal optical gates that are essentially capacitive loads. This paper describes a simplified procedure for designing these pulse amplifiers. It further outlines the use of bridged-T constant resistance networks to transform load capacitance into pure resistance, independent of frequency.

24981 (CONF-790622—, pp 250-253) **Vacuum arc switched inverter tests at 2.5 MVA.** Miller, R.N.; Gilmour, A.S. Jr. (State Univ. of New York, Buffalo). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A mathematical analysis of the unloaded vacuum arc switch (VAS) inverter is undertaken; a key element in this analysis is the assumption of a constant voltage drop of 50 volts across each VAS while it is conducting. From this analysis a constant VAS-voltage model is developed to explain the VAS inverter operation. A comparison of data obtained from laboratory tests of the inverter is made with data obtained from this model, and agreement is found to be within 10% for up to 15 alternations.

24982 (CONF-790622—, pp 273-275) **Electric discharge characteristics of cable PFN used as a pump.** Butcher, R.R.; Gurbaxani, S.H. (Los Alamos Scientific Lab., NM; Univ. of New Mexico, Los Alamos). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The cable pulse forming network (PFN) is an excellent pump for transverse discharge lasers. The effect of load characteristics on PFN design is discussed in detail. Experimental results are presented for a rare gas halide laser pumped by a cable PFN.

24983 (CONF-790622—, pp 276-283) **TRIDENT - a megavolt pulse generator using inductive energy storage.** Conte, D.; Ford, R.D.; Lupton, W.H.; Vitkovitsky, I.M. (Naval Research Lab., Washington, DC). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A megavolt level pulse generator, TRIDENT, has been constructed utilizing an inductive store as the primary pulse forming device. The 2.5 μH coaxial storage inductor can be energized with up to 500 kA obtained from a 500 kJ, 60 kV capacitor bank. Current interruption is accomplished using a three stage opening switch comprised of an explosively actuated switch in parallel with foil and wire fuses. The generator has been operated at the 410 kA charge level (70% energy) to produce 700 kV pulses with risetimes of 150 nsec. Energy has been deposited into a 7.5 Ω resistive load at a rate of 5 x 10^{10}W. Operation with optimized fuse dimensions and at full charge is anticipated to approach megavolt outputs at powers of 10^{11}W. Future experiments include utilizing a homopolar generator as the current source.

24984 (CONF-790622—, pp 284-286) **Inductive storage - prospects for high power generation.** Burton, J.K.; Conte, D.; Ford, R.D.; Lupton, W.H.; Scherrer, V.E.; Vitkovitsky, I.M. (Naval Research Lab., Washington, DC). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Recent progress in the development of key elements of high power inductive storage systems makes it possible to generate high power pulses using energy storage systems (other than explosive generators) that include single-pulse inductive systems, hybrids (inductor/pulse line and inductive devices for steepening of the capacitor output) as well as inductive systems for generation of high power pulse trains. Prospects for further development of opening switches and storage systems suggest potential near-term payoff. Improvements based on such developments can be expected to impact system efficiency, compactness and operational convenience.

24985 (CONF-790622—, pp 287-294) **Considerations for inductively driven plasma implosions.** Smith, D.L.; Henderson, R.P.; Reinovsky, R.E. (Air Force Weapons Lab., Kirtland AFB, Albuquerque, NM). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Inductive pulse forming techniques appropriate for the driving of imploding plasmas have been explored with special attention given to a suitable opening switch. Parametric investigations of circuit models indicate that imploding load performance is relatively independent of opening switch parameters. Extrapolation of existing experimental and computer simulated data leads to conceptual design criteria for a fused metal foil opening switch which will be implemented on a 1.9 MJ system. The inductive system compares favorably with the direct capacitor driven system in terms of kinetic energy with the definite advantage of shorter time scales on which the energy is delivered to the implosion.

24986 (CONF-790622—, pp 295-300) **High repetition rate miniature triggered spark switch.** Rose, M.F.; Glancy, M.T. (Naval Surface Weapons Center, Dahlgren, VA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A miniature triggered spark switch designed to operate at high repetition rates has been constructed. The device, along with associated trigger circuitry, has been incorporated into a simple L-C generator which produces an oscillatory discharge at a frequency of 150 MHz. The switch is operated in the pressure range 760 torr - 2.6 x 10^3 torr using commercial dry nitrogen as the working gas. Both brass and aluminum electrodes were investigated for repetition frequencies as high as 20 kHz and for gas flow rates as high as 8 cm^3/sec. The effect of repetition rate on switch jitter and switch breakdown voltage is presented and discussed in terms of gas pressure and flow rate.

24987 (CONF-790622—, pp 301-307) **Surface aging in high repetition rate spark switches with aluminum and brass electrodes.** Glancy, M.T.; Rose, M.F. (Naval Surface Weapons Center, Dahlgren, VA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The surface aging of the electrodes of miniature spark switches (A/d ~ 50) is explored using commercial dry nitrogen as the working gas. Both brass and aluminum electrodes were investigated for aging characteristics using a constant gas flow rate of 8 cm^3/sec. The gas pressure was varied from 760 torr to 5200 torr. The switches were constructed as an integral part of a miniature L-C oscillator which has a ringing frequency of approximately 150 MHz. The aging process was halted at intervals ranging from one to several thousand discharges and the electrode surface examined with a scanning electron microscope.

24988 (CONF-790622—, pp 308-312) **Spark gap erosion results.** Petr, R.; Barrett, D.; Burkes, T.R. (Texas Tech Univ., Lubbock). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The erosion characteristics of a spark gap with parallel-plane electrodes are determined at atmospheric and vacuum pressures. Erosion as a loss of electrode material is measured in a range from 200 to 1000 amperes. The severity of electrode erosion is found to be related to spot formation, switching rates, melting point of the electrode, pressure, and gap length. Erosion values for a pulsed current are given for aluminum, brass, and carbon.

24989 (CONF-790622—, pp 313-319) **Long-life high-repetition-rate triggered spark gap.** Watson, H. (AiResearch Manufacturing Co. of California, Torrance). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A forced-air-blown triggered spark gap (TSG) switch system capable of high repetition rates on a continuous basis as well as a TSG comparative study is described. The system consists of two TSG's, each discharging its own 30-ohm pulse cable into a common load. The system was operated at 30 kv, 1 kHz, for 39 x 10^6 shots with erosion rates of approximately 60 mg/amp-hour. Each TSG discharged 0.423 joules in 60 nsec (FWHM) per pulse. The switching losses were about 28% of the stored cable energy. Calculations indicate this can reduce to 14% by optimizing the TSG design and surrounding air channel insulation for a more uniform E-field. Test results indicate a multielement assembly capable of switching 50 ka or more 40- to 100-nsec pulses at 1 kHz from 50 kV for 500 x 10^6 shots without gap adjustment is feasible with this concept. The work was partially supported by the US Energy Research and Development Administration under Contract No. EN-77-C-04-4048.

24990 (CONF-790622—, pp 320-324) **Testing of a 100 kV, 100 Hz rep-rate gas switch.** Ramrus, A.; Shannon, J. (Maxwell Labs., Inc., San Diego, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A two-electrode gas switch with a self-breakdown voltage of 100 kV was operated at a pulse-repetition rate of 100 Hz with bursts up to 10 seconds in duration. The output of a pulse transformer provided the (1 - cos wt) waveform which charged the switch in about one-half millisecond. The switch discharged with a peak current of about 10 kA and a total charge transfer of about 10 mC into a damped LC circuit. A continuous purge of air through the interelectrode spacing enabled the switch to recover its breakdown voltage between discharges. Flow rates up to 35 SCFM were employed. This paper discusses the dependence of switch jitter and waveform reproducibility on air-flow rate.

24991 (CONF-790622—, pp 325-329) **Rebuilding the five megajoule homopolar machine at the University of Texas.** Gully, J.H.; Tolk, K.M.; Zowarka, R.C.; Brennan, M.; Bird, W.L.; Weldon, W.F.; Rylander, H.G.; Woodson, H.H. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The role of the 5 MJ homopolar machine at the Center for Electromechanics has changed from that of a pulsed power supply experiment to that of a power supply for various experiments. Because of this change in duty, it was necessary to modify the machine to allow more efficient operation and easier connection of the machine to the load.

24992 (CONF-790622—, pp 330-332) **Computer based electrical analysis of homopolar generator driven, bitter plate storage inductors with radial current diffusion.** Mayhall, D.J.T.; Rylander, H.G.; Weldon, W.F.; Woodson, H.H. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Maxwell's equations are solved for the operational admittance in the magnetic quasi-static approximation for nonmagnetic cylindrical coils with aximuthal currents and axial magnetic fields. An infinite series, Bessel function solution is obtained and solved for copper coils with given radial dimensions. Coil turns numbers and lengths are design parameters. A multiple branch, shunt network coil model with series resistances and inductances is derived. The UT CEM 5 MJ homopolar generator is modeled with a torque-speed equation including brush and seal drag torques. The brush contact voltage drop is modeled versus surface speed and brush current. Transmission system resistances and inductances are included. Effective depths of current penetration, effective coil resistances and inductances, and peak temperatures are calculated versus time. Coil currents and voltages are obtained, as are system energy storages and dissipations. Peak current times and system discharge times are determined. Slightly underdamped configurations are found.

24993 (CONF-790622—, pp 333-342) **Testing and analysis of a fast discharge homopolar machine (FDX).** Bullion, T.M.; Zowarka, R.; Driga, M.D.; Gully, J.H.; Rylander, H.G.; Tolk, K.M.; Weldon, W.F.; Woodson, H.H. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The Fast Discharge Experiment (FDX) is a 0.36 MJ, 200 V homopolar machine designed to discharge in one millisecond. This experiment is intended to establish the fundamental limitations involved in extracting energy in the shortest time from a flywheel using homopolar conversion. After initial testing of FDX was completed and data was analyzed, problems limiting performance were identified. Various components of the machine were redesigned and modified to correct these problems. A second set of tests, including short circuit discharges from various speeds, has recently been conducted. Results and analysis of these tests will be presented. New problems encountered as well as recommendations for additional work will also be given.

24994 (CONF-790622—, pp 347-350) **Preliminary inductive energy transfer experiments.** Henderson, R.P.; Smith, D.L.; Reinovsky, R.E. (Air Force Weapons Lab., Kirtland AFB, Albuquerque, NM). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The use of inductive storage systems has been studied as an attractive alternative to the more conventional capacitive energy storage systems to drive a cylindrical imploding plasma and produce x-rays for nuclear simulation. Preliminary experiments have been conducted using a 200 kJ, 4 μs capacitor bank to explore the basic performance of electrically exploded foil opening switches. Peak voltage and opening time have been characterized as a function of quench media and capacitor bank risetime. Risetime and energetic efficiency of current transfer to inductive dummy loads have also been measured. These experimental results are contributing to conceptual designs for a 1.9 MJ capacitor driven inductive pulse shortening system.

24995 (CONF-790622—, pp 355-358) **Safety grounding switches in large experiments; general considerations and the TEXT application.** Wildi, P. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The electrical installations of a large fusion experiment present many potential dangers such as residual charges on capacitor banks and cables, power rectifiers and other related power supplies, etc. The commonly used voltages of 1 to 20 kV are lethal and the available power is sufficient to cause severe arc damage. The paper reviews some commonly employed practices and discusses the adequacy and safety of various grounding devices. The safety grounding scheme for the TEXT Tokamak is described. Specially designed switches, their contact and operating mechanism, are shown and the integration of the switches in the overall control and safety system is discussed.

24996 (CONF-790622—, pp 359-362) **Inductance and resistance characteristics of single-site untriggered water switches in water transfer capacitor circuits.** Spence, P.W.; Chen, Y.G.; Frazier, G.; Calvin, H. (Physics International Co., San Leandro, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Inductance and resistance characteristics of single-site untriggered water switch arc-channels have been investigated by measurement of their effects on frequency and voltage gain in a water capacitor transfer circuit. Data are presented for two distinct switch configurations covering a voltage range from 3 to 6 MV, gaps from 7 to 35 cm, and mean switching fields from 150 to 350 kV/cm. A simple lumped circuit model is postulated with switch L and R varying linearly with gap spacing under low voltage conditions. Extrapolation of this zero-order model to higher voltage conditions compares favorably with measured circuit characteristics. Energy loss in the water switch is observed to be approximately a factor of two in excess of maximum losses predicted from previous estimates.

24997 (CONF-790622—, pp 364-367) **High frequency thyratron evaluation.** Hill, G.A.; Burkes, T.R. (BDM Corp., Albuquerque, NM; Texas Tech Univ., Lubbock). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The high frequency characteristics of a triple grid thyratron are investigated. The pentode thyratron has three closely spaced grids and operates much like a conventional tetrode thyratron. The first grid has a dual function. It functions as a priming grid, preionizing the grid cathode space, as well as a shield grid, isolating the control grid from the cathode plasma during the recovery phase. The second grid is the control grid, with negative control characteristics. The third grid is a shield grid, designed to enhance the control grid aperture deionization. This thyratron is tested in a line-type pulser to determine its high frequency limitations. It proves capable of operating at pulse repetition frequencies of up to 180 kHz.

24998 (CONF-790622—, pp 368-371) **Repetitive electron beam controlled switching.** Fernsler, R.F.; Conte, D.; Vitkovitsky, I.M. (Naval Research Lab., Washington, DC). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Previous investigators have demonstrated the feasibility of using an ionizing electron beam to control the conductivity of a gaseous, volume-discharge switch. We have considered the possibility of using such switches repetitively at high power levels (up to 10^{10}W), with switch opening and closing times as short as several nanoseconds. An analysis of the relevant gas chemistry has indicated that these requirements can best be met by using a non-electronegative base gas diluted with a small percentage of an electronegative gas. Detailed chemistry simulations, using the non-electronegative gas N_2 and the electronegative gas O_2, have been performed and will be presented to support this analysis. Also discussed will be the limitations imposed by switch heating and gas breakdown.

24999 (CONF-790622—, pp 372-375) **Orientation independent ignitron.** Harvey, R.J.; Bayless, J.R. (Hughes Research Labs., Malibu, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

An orientation independent ignitron (OII) has been operated at 30 kV, 15 kA with 10 μsec wide pulses at frequencies up to 100 Hz. The cathode of the OII is a thin mercury film which is held in place by surface tension on a cooled molybdenum substrate. This device has been shown to have a basic voltage withstand of over 60 kV, trigger characteristics comparable to conventional ignitrons, a current rate of rise in excess of 10 kA/μs at 30 kV, and a mean stable run time at 8 A average current of 22 s in the burst mode. Reformation of the film occurs during and following the pulse burst with a recycle time on the order of 10 min.

25000 (CONF-790622—, pp 376-380) **Stabilization of metal-oxide bulk switching device with diffused Bi contacts.** Lalevic, B.; Shoga, M.; Gvishi, M.; Levy, S. (Rutgers - the State Univ., Piscataway, NJ; Army ERADCOM, Ft. Monmouth, NJ). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Threshold switching from the high to low resistance state has been investigated in the polycrystalline and single crystal NbO/sub x/ (where x is approximately = 2) metal-oxide devices. Stable and reproducible switching performance is observed in a configuration Bi-NbO_2-Bi where Bi electrodes were covered with Au films. Improvement in the device performance is attributed to the Bi diffusion into NbO/sub x/ which has been confirmed by the Auger electron spectroscopy. Typical off state resistance of these devices is ~100 KΩ and threshold switching voltage in the range from 100 to 2500 V. The delay time tau/sub d/ is exponentially dependent on the applied voltage V/sub appl/ and at larger V/sub appl'/ the delay time is less than a nanosecond. Recovery time of a device is ~0.5 μsec as determined by the method of decreasing time interval between two successive pulses. Holding voltage is ~40 V. The pulsed switched devices can withstand pulse durations between 0.1 to 3 μsec, repetition rate of 100 C/s and current intensities of 10 to 15 A, or 25 A peak with the applied pulse duration of 20 μsec, single shot.

25001 (CONF-790622—, pp 385-391) **Design of the armature windings of a compensated pulsed alternator engineering prototype.** Gully, J.H.; Bird, W.L.; Bullion, T.M.; Rylander, H.G.; Weldon, W.F.; Woodson, H.H. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The design of the armature windings of a 6 kV, 70 kA compensated pulsed alternator engineering prototype now under construction at The University of Texas at Austin is presented. Electromagnetic forces acting on the windings and the resulting mechanical and electrical stresses placed on the armature insulation

are given. Test results of a program to select the ground plane insulation system are described. Finally, fabrication methods, tooling, and problems encountered during construction are discussed.

25002 (CONF-790622—, pp 392-397) **Mechanical design of a compensated pulsed alternator prototype.** Brennan, M.; Bird, W.L.; Gully, J.H.; Spann, M.L.; Tolk, K.M.; Weldon, W.F.; Rylander, H.G.; Woodson, H.H. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A prototype of a compensated pulsed alternator (compulsator) is presently under construction at the Center for Electromechanics (CEM) of The University of Texas at Austin. The unique machine configuration and peak output current (150 kA) generate large forces not typically seen by conventional rotating machines. The rotor is made of 2913 laminations shrink fitted on a vertical shaft. Since the rotor has an L/D of 3.2 and a maximum speed of 5400 rpm, these insulated laminations are clamped on the ends with large Belleville washers to increase the effective stiffness. The stator is mounted on a torque frame which allows it to rotate during discharge to reduce the forces transmitted to ground. The mechanical considerations and design of this machine are presented.

25003 (CONF-790622—, pp 398-401) **Design, assembly, and testing of a desk model compensated pulsed alternator.** Pichot, M.A.; Bird, W.L.; Brennan, M.; Driga, M.D.; Gully, J.H.; Rylander, H.G.; Tolk, K.M.; Weldon, W.F.; Woodson, H.H. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The Center for Electromechanics (CEM) at The University of Texas is currently involved in the design, fabrication, and testing of a prototype compensated pulsed alternator (compulsator). This machine, a new concept in pulsed power technology, utilizes the principles of magnetic induction and flux compression to convert rotational energy directly into electrical energy. The subject of this paper is a one-fifth scale version of the CEM prototype. This desk model compulsator is a portable demonstration machine designed to operate in the same fashion as the full scale model.

25004 (CONF-790622—, pp 406-409) **Application of subsystem summary algorithms for high power system studies.** Brockhurst, F.C. (Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

This paper describes the application of subsystem summary algorithms for self-contained power system configuration trade-off studies and presents the results of a recently completed study. The development of summary weight algorithms for rocket turbines and rotating electrical generators is described. These new algorithms are combined with previously developed power conditioning subsystem algorithms in a computer program to automatically study various system configurations. A flow chart of the computer program is included in the paper. The computer program was used to find a minimum weight self-contained power system. Results of the study are presented in this paper.

25005 (CONF-790622—, pp 410-413) **Computerized measuring system for nanosecond risetime pulsed accelerators.** Pellinen, D.; Ashby, S.; Gillis, P.; Nielson, K.; Spence, P. (Physics International Co., San Leandro, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

We have developed a new computerized diagnostic system for high voltage, high current pulsers. This diagnostic system uses electronic circuits connected to nanosecond response transducers to measure machine performance at critical points. The voltage outputs of these circuits are converted to digital form and directly read by a computer. The major advantages of this system are cost effectiveness and greater accuracy than commonly used oscilloscope or transient analyzer systems in applications where it is not necessary to record full analog diagnostic waveforms. Operation is fully computerized and requires a minimum number of personnel; the system is scalable to very large multi-module generators.

25006 (CONF-790622—, pp 425-428) **Distributed parameter model of the TRESTLE pulser.** Lehman, T.H.; Hutchins, R.L.; Fisher, R. (BDM Corp., Albuquerque, NM). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A distributed parameter circuit analog model was developed to evaluate design improvements for the TRESTLE pulser. The approach for specifying the model network and estimating model parameters is given. Model results are shown to compare favorably to available measurements. The model's flexibility and economy allowed ready evaluation of potential modifications.

25007 (CONF-790622—, pp 433-436) **Simulation of inductive and electromagnetic effects associated with single and multichannel triggered spark gaps.** Levinson, S.; Kunhardt, E.E.; Kristiansen, M.; Guenther, A.H. (Texas Tech Univ., Lubbock). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

When breakdown of a pressurized spark gap is initiated by a high power laser, a narrow spark channel is quickly established. In this case, the risetime of the current in the external circuit due to the breakdown of the gap is determined in a large measure by the properties of this spark channel. To study the inductive and electromagnetic effects associated with the channel dimensions and the resulting physical discontinuities, experiments have been conducted using spark gaps where the discharge channel is simulated by a very thin wire. Current risetime measurements for various wire sizes (i.e., spark channel radius), wire position (i.e., on or off axis), and number of wires (i.e., multichanneling) have been carried out. The risetime values thus obtained agree quite well with the laser-triggered, single and multichannel, spark gap results. These results can be qualitatively explained using simple inductive circuits which dramatically underline the inductive character of the breakdown. The significance of these results in revealing the mechanism of spark gap breakdown will be discussed.

25008 (CONF-790622—, pp 437-441) **Electron-beam-triggered spark gap.** McDonald, K.; Newton, M.; Kunhardt, E.E.; Kristiansen, M.; Guenther, A.H. (Texas Tech Univ., Lubbock; Air Force Weapons Lab., Kirtland AFB, Albuquerque, NM). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Studies on the triggering of a high-voltage, gas-insulated spark gap by an electron beam have been conducted. Risetimes of approximately 2.5 ns and subnanosecond jitter have been obtained for 3 cm gaps with gap voltages as low as 50% of the self-breakdown voltage (variable to 1 MV). The switch delay (including the diode) was 50 ns. The working media were N_2, and mixtures of N_2 and Ar, and of N_2 and SF_6 at pressures of 1 to 3 atm. Open shutter photographs show that the discharge is broad in cross-section. Voltage, current, and jitter measurements have been made for a wide range of gap conditions and electron-beam parameters. Variations in the character of the discharge have been inferred using streak and open shutter photography. Correlation between electron beam width, beam energy, discharge channel width, current risetime, delay, and jitter are discussed.

25009 (CONF-790622—, pp 442-445) **Low jitter laser triggered spark gap using fiber optic.** Hatfield, L.L.; Harjes, H.C.; Kristiansen, M.; Guenther, A.H.; Schoenback, K.H. (Texas Tech Univ., Lubbock). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Laser triggering of a pulse charged gas switch is described. The laser triggering results in low jitter switching relative to the timing of the laser pulse. A novel feature is the use of a single ele-

ment, 1mm, quartz, optical fiber to transmit the laser beam. The switch parameters, such as gas pressure, gas composition, and laser beam focal point location have been optimized to produce nanosecond delay and jitter with as little laser power as possible. The laser optical system has been optimized for best overall efficiency in a configuration suitable for illumination of many fibers by a single laser. Typical operating parameters for the switch are: 2 cm gap, 2500 torr pressure, 50% Ar - 50% N_2 gas mixture, and a charging voltage of 200 kV. Laser power in the gap is typically a few megawatts with an overall efficiency greater than 50% for the optical system.

25010 (CONF-790622—, pp 446-449) **3-MV low-jitter triggered gas switch.** Cummings, D.B.; Hammon, H.G. III. (Physics International Co., San Leandro, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Physics International Company has designed, built, and tested a 3 MV, low jitter, triggered gas switch. The switch operates in a 16.5 Ω coaxial pulse line. The system design requires that the pulse line switches perform the difficult task of first holding off a reverse pulse charge, then of holding off the forward pulse charge, then, finally, of triggering on command. The trigger for the switch is generated by a trigger Marx placed within the output pulse line. The remainder of the triggering circuit includes a trigger isolation gap. A V/N-type trigger electrode is situated within the main gap. To date, the switch has been shown to hold voltage and trigger reliably for pulse charges from 0.9 MV to 2.5 MV. The rms jitter of the switch firing time is less than 6 ns. At an operating voltage of 2.5 MV, the switch transfers a charge of up to 0.1 coulomb per shot, with a peak current of 80 kA.

25011 (CONF-790622—, pp 450-453) **Characterization of high power gas switch failure mechanisms.** Nolting, E.E. (Naval Surface Weapons Center, Silver Spring, MD). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A multistage, 4 MV, low jitter, command triggered gas switch is being developed for use on large pulse power devices. Experiments to date have shown that the performance and operational life of the switch are severely limited by mechanical and electrical failure of the insulating housing. Estimates of the internal overpressure produced during switch closure have been made which indicate the severity of the blast containment problem; this information has led to the development of a mechanically stronger switch design. Surface analyses performed on both switch electrode and insulator surfaces were used to investigate observed electrical failure of the insulators. A layer of closely spaced metal particles were found imbedded in the insulator walls.

25012 (CONF-790622—, pp 463-466) **Applying a compensated pulsed alternator to a flashlamp load for NOVA. Part II.** Bird, W.L.; Mayhall, D.J.T.; Weldon, W.F.; Rylander, H.G.; Woodson, H.H. (Univ. of Texas, Austin). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

The compensated pulsed alternator (compulsator) has been proposed as a possible alternative to capacitor banks for driving xenon flashlamps for pumping neodymium glass laser amplifiers for NOVA. An algorithm for sizing rotor diameter and angular velocity as a function of flashlamp impedance, peak current, and delivered energy is described. It is shown that the armature inductance variation is a major consideration when matching the pulsed alternator to the load. Finally, conceptual design parameters of a four pole, laminated rotor compulsator are presented.

25013 (CONF-790622—, pp 471-474) **Fast rising transient heavy current spark damage to electrodes.** Watson, A. (Texas Tech Univ., Lubbock; Univ. of Windsor, Ontario). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

Crests of displaced metal have been observed in rings beyond the crater produced on electrodes by short duration (10 to 100 ns) heavy current sparks in a variety of dielectric media. Metal is presumed to have melted and flowed radially, the hydromagnetic forces supporting a standing canal wave which is identified with the crest. Analysis shows this situation to be invariant under steady melting and the ring diameter is proportional to the square root of spark current, as measurement verifies. Erosion is proposed to occur by the breaking of this crest or by its removal under the action of electrostatic forces, in accord with reported experimental data.

25014 (CONF-790622—, pp 483-486) **Magnetic insulation in short coaxial vacuum structures.** Di Capua, M.S.; Sullivan, T.S. (Physics International Co., San Leandro, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

magnetically insulated vacuum structures (MIVS) can be used to overcome the limitation on power flow in liquid dielectrics and dielectric vacuum interfaces in pulsed high power accelerators. A short (1 m), low-impedance ($Z_o = 5\Omega$) coaxial MIVS with a gap of 5 mm was studied experimentally. Power flows of 1.5×10^{10} W cm^{-2} were observed. The current pulse showed some erosion before the onset of magnetic insulation. The transverse electron current arising from this erosion was observed with Faraday cups imbedded in the wall. Magnetic insulation was lost about 60 to 70 ns into the pulse. This loss was also observed in the Faraday cups and radiation diagnostics. This loss of magnetic insulation is associated with closure of the gap by cathode plasma.

25015 (CONF-790622—, pp 487-490) **Low-inductance 2-MV tube.** Chen, Y.G.; Mashima, K.; Benford, J. (Physics International Co., San Leandro, CA). 1979. NTIS, PC A22/MF A01. File Number DE85000613.

From 2. international pulsed power conference; Lubbock, TX, USA (12 Jun 1979).

A new multi-stage low-inductance tube for the coaxial water generator OWL II has been designed. Low inductance is achieved by means of a plastic lens in the water, which produces a field distribution with improved uniformity.

25016 (CONF-850310—47) **Current state of development and expected performance of copper-lithium alloys as an impurity control system in fusion applications.** Brooks, J.N.; Gruen, D.M.; Krauss, A.R.; Mattas, R.F.; DeWald, A.B. (Argonne National Lab., IL (USA); Georgia Inst. of Tech., Atlanta (USA)). 1985. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009673.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

A new approach to impurity control involves the development of materials displaying both strong surface segregation of a low-Z component and high secondary ion fractions in the sputtering of that component. Key issues that have been studied with particular reference to copper-lithium alloys relate to the completeness of the overlayer, its rate of formation in a reactor environment, lowering of substrate sputtering and self-sputtering yields, durability of the overlayer, and depletion of the bulk alloy in the low-Z component. Other factors that must be considered in the materials selection process relate to response to disruptions, heat transfer, thermal stress, fabricability, radiation damage, activation, and tritium permeation. Copper-lithium alloys have been evaluated as a surface material for the impurity control system of the INTOR reactor. Both the medium-edge temperature limiter regime and the low-edge temperature divertor regime were examined. The analysis used TRIM code data to predict sputtering coefficients for copper-lithium with a 1.5 monolayer coverage of lithium. The REDEP code was used to evaluate the erosion performance for INTOR. Other properties such as fabrication and thermal performance were also briefly assessed. It was found from the standpoint of erosion that copper-lithium is a very good candidate material for the medium-edge temperature regime and also works well in the low-edge temperature regime. For the medium-edge temperature regime, the use of copper-lithium results in an almost negligible erosion rate over the entire surface.

25017 **(CONF-850310—64) TFCX shielding optimization.** Yang, S.; Gohar, Y. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010503.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Design analyses and tradeoff studies for the bulk shield of the Tokamak Fusion Core Experiment (TFCX) were performed. Several shielding options were considered to lower the capital cost of the shielding system. Optimization analyses were carried out to reduce the nuclear responses in the TF coils and the dose equivalent in the reactor hall one day after shutdown. Two TFCX designs with different toroidal field (TF) coil configurations were considered during this work. The materials for the shield were selected based upon tradeoff studies and the results from the previous design studies. The main shielding materials are water, concrete, and steel balls (Fe1422 or Nitronic 33). Small amounts of boron carbide and lead are employed to reduce activation, nuclear heating in the TF coils, and dose equivalent after shutdown.

25018 **(CONF-850310—65) MFTF-α + T shield design.** Gohar, Y. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010496.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

MFTF-α+T is a DT upgrade option of the Tandem Mirror Fusion Test Facility (MFTF-B) to study better plasma performance, and test tritium breeding blankets in an actual fusion reactor environment. The central cell insert, designated DT axicell, has a 2-MW/m^2 neutron wall loading at the first wall for blanket testing. This upgrade is completely shielded to protect the reactor components, the workers, and the general public from the radiation environment during operation and after shutdown. The shield design for this upgrade is the subject of this paper including the design criteria and the tradeoff studies to reduce the shield cost.

25019 **(CONF-850310—66) Hot spots in the inboard section of the TFCX toroidal field coils.** Yang, S.; Gohar, Y. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010495.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

The TFCX conceptual designs call for the construction of the reactor torus through the use of "pie-shaped" segments for mechanical and maintenance considerations. The use of this concept results in hot spots in the inboard section of the torodial field (TF) coils due to neutron and photon streaming through the slots between the segments. This work studies these effects on the nuclear responses in the TF coils and introduces design solutions to reduce the impact on the reactor design.

25020 **(CONF-850310—67) Systematic methodology for estimating direct capital costs for blanket tritium processing systems.** Finn, P.A. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010502.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

This paper describes the methodology developed for estimating the relative capital costs of blanket processing systems. The capital costs of the nine blanket concepts selected in the Blanket Comparison and Selection Study are presented and compared.

25021 **(CONF-850310—68) FELIX experiments: measurements of electromagnetic effects.** Turner, L.R.; Evans, K. Jr.; Gunderson, G.R.; Kim, S.; Knott, M.J.; McGhee, D.G.; Praeg, W.F.; Wehrle, R.B. (Argonne National Lab., IL (USA)). 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010497.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Three major series of experiments have been conducted with the FELIX facility at ANL. Experiments on the coupling between eddy currents and angular displacements of loops and plates in crossed constant and changing magnetic fields demonstrated that the coupling effects reduced the peak currents and deflections. These experiments were carried out by a team of investigators from Princeton Plasma Physics Laboratory (PPPL) and ANL and are reported elsewhere. Experiments measuring eddy current effects in flat plates provided data to validate 2-D and 3-D eddy current computer codes. Experiments measuring eddy current effects in hollow cylinders with different ratios of thickness to diameter explored the limitations of using 2-D codes to model 3-D geometries. The plate and cylinder experiments are described in detail.

25022 **(CONF-850310—69) MIG: MCNP input generator for EFFI magnet geometries.** Attaya, H.; Gohar, Y. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.; Argonne National Lab., IL (USA)). Mar 1985. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010494.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

A computer code, MIG, has been developed to interface the magnet design and the three-dimensional Monte Carlo code MCNP to perform neutronics design analyses. MIG prepares all the required MCNP cells and surfaces to simulate the magnets described in EFFI input. Extra zones with different materials could be added to envelop or divide the winding packs of the magnets. Examples of the input and output of MIG used by MCNP are given to illustrate the different capabilities of MIG.

25023 **(CONF-850610—26) Poloidal variations in toroidal fusion reactor wall power loadings.** Carroll, M.C.; Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1985. Contract AC02-76ET52040. 6p. (COO—2218-315). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009505.

From Annual meeting of the American Nuclear Society; Boston, MA, USA (9 Jun 1985).

A geometric formulation is developed by the authors for determining poloidal variations in bremmstrahlung, cyclotron radiation, and neutron wall power loadings in toroidal fusion devices. Assuming toroidal symmetry and utilizing a numerical model which partitions the plasma into small ceils, it was generally found that power loadings are highest on the outer surface of the torus, although variations are not as large as some have predicted. Results are presented for various plasma power generation configurations, plasma volume fractions, and toroidal aspect ratios, and include plasma and wall blockage effects.

25024 **(CONF-8503123—1) Whist code calculations of ignition margin in an ignition tokamak.** Sheffield, J. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85009507.

From Ignition design point workshop; Princeton, NJ, USA (12 Mar 1985).

A simple global model was developed to determine the ignition margin of tokamaks including electron and ion conduction losses. A comparison of this model with results from a 1 1/2 dimensional Whist code is made. (MOW)

25025 **(DOE/DP/40191—1) Ion beam-plasma interactions. Final report, September 1, 1983-August 31, 1984.** DeGroot, J.S. (California Univ., Davis (USA). Dept. of Applied Science). 22 Mar 1985. Contract AS08-83DP40191. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010202.

The purpose of this study was to design experiments that model the fast ion plasma interaction region in a heavy ion driven inertial confinement fusion (HIF) pellet. The effort consisted of (1) construction and testing of the experimental device and (2) preliminary experiments. The results of this work are reported.

25026 **(DOE/DP/40194—1) Studies of the two plasmon decay and stimulated Raman scattering instabilities in hot long scalelength plasmas. Final report.** Ebrahim, N.A.; Chen, F.F.; Joshi, C. (Yale Univ., New Haven, CT (USA). Dept. of Applied Physics; California Univ., Los Angeles (USA). Dept. of Electrical Engineering). 26 Feb 1985. Contract AS08-84DP40194. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85010199.

The experiments described in this paper were conducted on the GDL laser system at the University of Rochester's Laboratory for Laser Energetics. (1) During this period we conducted studies of Raman backscatter and two plasmon decay from thin foil targets irradiated by a high intensity 0.35 μm laser beam. The major conclusions of the work on thin foils are: (a) We have observed stimulated Raman back and side scattering, apparently below the convective Raman threshold for a linear density profile. (b) The scattered spectrum shows a splitting around $w_o/2$ which is not fully understood, but it is most probably caused by mode conversion of the plasma waves from 2w/sub p/ decay into electromagnetic waves. (c) High-energy electrons were observed from plasmas with densities below n/sub c/. The generation mechanism seems to be more efficient at n/sub c/4.

25027 **(DOE/ER—0045/13) Alloy development for irradiation performance. Semiannual progress report for period ending September 30, 1984.** (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 239p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE85010454.

Separate abstracts were prepared for each of the included sections. (MOW)

25028 (DOE/ER—0046/18, pp 11-17) **Measurement of Cu spallation cross sections at IPNS.** Greenwood, L.R.; Smither, R.K. (Argonne National Lab., IL). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

Spallation cross sections for Cu have been measured at the IPNS at Argonne National Laboratory. Results are reported for the production of 21 different radioisotopes at 13 different energies between 25 and 450 MeV. These data are now being tested for spectral adjustments at IPNS and LAMPF and some preliminary results are reported.

25029 (DOE/ER—0046/18, pp 122-132) **Effect of void surface motion on the void sink strength for point defects.** Bullough, R.; Ghoniem, N.M. (Atomic Energy Research Establishment, Harwell, England). Aug 1984. NTIS, PC A08/MF A01. File Number DE85002680.

In Damage analysis and fundamental studies. Quarterly progress report, April-June 1984.

By a generalization of an analysis due to Frank of the growing precipitate we derive an analytic sink strength for the growing void that takes account of the void surface motion in a self-consistent fashion. The lower mobility of the vacancies compared to the interstitials ensures that a growing void captures more vacancies than the usual quasi-static void. The various consequences of this void bias for vacancies are discussed in relation to the swelling of reactor materials.

25030 (DOE/ER/10275—1C, pp 1, Paper 20) **Applications of cryogenic magnets in fusion reactors.** Wan, A.S. (Massachusetts Institute of Technology, Cambridge). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

25031 (DOE/ER/10275—1C, pp 1, Paper 22) **Radiation damage in fusion systems.** Poploski, M. (Pennsylvania State Univ., University Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

25032 (DOE/ER/10275—1C, pp 1, Paper 23) **Analysis of the plasma impurity influx from self-sustaining alkali-metal coatings for fusion reactor applications.** DeWald, A.B. Jr. 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

25033 (DOE/ER/10275—1C, pp 1, Paper 24) **Surface topography and interface width measurements of multilayered structures bombarded by energetic ion beams.** Davarya, F. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

25034 (DOE/ER/10275—1C, pp 1, Paper 25) **Simulation of ion-bombardment induced recoil mixing in binary alloys.** Davarya, F. (Maryland Univ., College Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

25035 (DOE/ER/10275—1C, pp 1, Paper 26) **Fusion-fission hybrid concept based on starfire.** Brokloff, N.A. (Pennsylvania State Univ., University Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

25036 (DOE/ER/10275—1C, pp 1, Paper 27) **Optimization of tritium production in the Tokamak Fusion Test Reactor.** Shah, P.N. (Pennsylvania State Univ., University Park). 1982. NTIS, PC A05/MF A01. File Number DE83004082. (CONF-820442—Absts.).

From American Nuclear Society regional student conference; Atlanta, GA, USA (16 Apr 1982).

25037 **(DOE/ID/01570—T95) Preliminary proposal for a beryllium technology program for fusion applications.** (Idaho National Engineering Lab., Idaho Falls (USA); Lawrence Livermore National Lab., CA (USA); Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1985. Contract AC07-76ID01570. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85009815.

The program was designed to provide the answers to the critical issues of beryllium technology needed in fusion blanket designs. The four tasks are as follows: (1) Beryllium property measurements needed for fusion data base. (2) Beryllium stress relaxation and creep measurements for lifetime modelling calculations. (3) Simplified recycle technique development for irradiated beryllium. (4) Beryllium neutron multiplier measurements using manganese bath absolute calibration techniques.

25038 (IPPJ—632, pp 128-135) **Self-reversal mechanism in the reversed field pinch.** Sato, T.; Kusano, K. (Hiroshima Univ. (Japan)). Apr 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE85780869. (CONF-830342—).

From US/Japan 3-D MHD workshop; Nagoya, Japan (8 Mar 1983).

Published in summary form only.

25039 **(ITEF—66(1983)) Numerical simulation of laser radiation interaction plane targets.** LatysheV, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1983. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. File Number DE85700836.

A plasma model intended for numerical investigation into the interaction of CO_2-laser radiation in the 10^9-10^{12} W/cm^2 range of flux density and 1-100 ns range of pulse duration with heavy ion flat targets is suggested. The targets may be both solid and gaseous

as a supersonic gas jet 10^{-2} to 10^{-1} cm thick with a 10^{18} to 10^{19} cm^{-3} atom concentration. A two-temperature hydrodynamic program in plane geometry with account of a side spread is described. A laser-produced plasma is simulated by "macroparticles" as infinitely thin disks of equal mass which can move along the symmetry axis and change in size. The program comprises the following physical processes: laser radiation absorption at due to the inverse bremsstrahlung mechanism and reflection from a critical density plasma layer; electron thermal conductivity with account of thermal flux limiting; heat exchange between electrons and ions at elastic collisions; ionization processes in the mean charge approximation with account of electron shock ionization; ternary-, dielectron- and photorecombination; ionization-radiative cool-down. The program permits to investigate the effectiveness of laser radiation absorption due to the inverse bremsstrahlung effect; plasma temperature and density distribution as well as mean ion charge distribution over the plasma corona; hardening and hydrodynamic acceleration of ions at a laser plasma recession.

25040 **(LA—10380) Summary of research for the Inertial Confinement Fusion Program at Los Alamos National Laboratory.** Cartwright, D.C. (comp.). (Los Alamos National Lab., NM (USA)). Mar 1985. Contract W-7405-ENG-36. 165p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE85010330.

The information presented in this report is a summary of the status of the Inertial Confinement Fusion (ICF) program at the Los Alamos National Laboratory as of February 1985. This report contains material on the existing high-power CO_2 laser driver (Antares), the program to determine the potential of KrF as an ICF driver, heavy-ion accelerators as drivers for ICF, target fabrication for ICF, and a summary of our understanding of laser-plasma interactions. A classified companion report contains material on our current understanding of capsule physics and lists the contributions to the Laboratory's weapons programs made by the ICF program. The information collected in these two volumes is meant to serve as a report on the status of some of the technological components of the Los Alamos ICF program rather than a detailed review of specific technical issues.

25041 **(LA-UR—85-513-Rev.) Steady-state spheromak reactor studies. Revision.** Krakowski, R.A.; Hagenson, R.L. (Los Alamos National Lab., NM (USA); Phillips Petroleum Co., Bartlesville, OK (USA)). 1985. Contract W-7405-ENG-36. 8p. (CONF-850310—18-Rev.). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009585.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

After summarizing the essential elements of a gun-sustained spheromak, the potential for a steady-state is explored by means of a comprehensive physics/engineering/costing model. A range of cost-optimized reactor design point is presented, and the sensitivity of cost to key physics, engineering, and operational variables is reported.

25042 **(LA-UR—85-747) KrF laser cost/performance model for ICF commercial applications.** Harris, D.B.; Pendergrass, J.H. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 7p. (CONF-850310—49). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE85009589.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Simple expressions suitable for use in commercial-applications plant parameter studies for the direct capital cost plus indirect field costs and for the efficiency as a function of repetition rate were developed for pure-optical-compression KrF laser fusion drivers. These simple expressions summarize estimates obtained from detailed cost-performance studies incorporating recent results of ongoing physics, design, and cost studies. Contributions of KrF laser capital charges and D and M costs to total levelized constant-dollar (1984) unit ICF power generation cost are estimated as a function of plant size and driver pulse energy using a published gain for short-wavelength lasers and representative values of plant parameters.

25043 **(LA-UR—85-748) Megajoule-class single-pulse KrF laser test facility as a logical step toward inertial fusion commercialization.** Harris, D.B.; Pendergrass, J.H. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 5p. (CONF-850310—48). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009590.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

The cost and efficiency of megajoule-class KrF laser single pulse test facilities have been examined. A baseline design is described which illuminates targets with 5 MJ with shaped 10-ns pulses. The system uses 24 main amplifiers and operates with an optics operating fluence of 4.0 J/cm^2. This system has 9.0% efficiency and costs $200/joule. Tradeoff studies indicate that large amplifier modules and high fluences lead to the lowest laser system costs, but that only a 20% cost savings can be realized by going to amplifier modules larger than 200 kJ and/or fluences greater than 4 J/cm^2. The role of the megajoule-class single-pulse test facility towards inertial fusion commercialization will also be discussed.

25044 **(LA-UR—85-790) Inertial fusion reactors and magnetic fields.** Cornwell, J.B.; Pendergrass, J.H. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 9p. (CONF-850310—50). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009571.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

The application of magnetic fields of simple configurations and modest strengths to direct target debris ions out of cavities can alleviate recognized shortcomings of several classes of inertial confinement fusion (ICF) reactors. Complex fringes of the strong magnetic fields of heavy-ion fusion (HIF) focusing magnets may intrude into reactor cavities and significantly affect the trajectories of target debris ions. The results of an assessment of potential benefits from the use of magnetic fields in ICF reactors and of potential problems with focusing-magnet fields in HIF reactors conducted to set priorities for continuing studies are reported. Computational tools are described and some preliminary results are presented.

25045 **(LA-UR—85-982) Cryogenic hydrogen isotope distillation for the fusion fuel cycle.** Sherman, R.H. (Los Alamos National Lab., NM (USA)). 1985. Contract W-7405-ENG-36. 20p. (CONF-850405—5). NTIS MF A01; 2; GPO Dep. File Number DE85009635.

From 2. national topical meeting on tritium technology in fission, fusion and isotopic applications; Dayton, OH, USA (30 Apr 1985).

Cryogenic distillation is an attractive method for the hydrogen isotopic separations required in fusion fuel cycles. The theoretical and practical aspects of designing and constructing such systems are well established. Practical considerations in the design of systems are presented and applied to the Isotope Separation System (ISS) at the Tritium Systems Test Assembly (TSTA), as well as systems of distillation columns that might be used for a reactor such as the Tokamak Fusion Core Experiment (TFCX) and the recovery of breeding blanket product.

25046 **(LBL—19031) Range-energy relation for Au ions, $E \leq 152$ MeV/amu.** Heckman, H.H.; Bowman, H.R.; Karant, Y.J.; Rasmussen, J.O.; Warwick, A.I.; Xu, Z.Z. (Lawrence Berkeley Lab., CA (USA)). Jan 1985. Contract AC03-76SF00098. 24p. (CONF-8409219—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009958.

From 2. international workshop on atomic physics for ion fusion; Chilton, UK (11 Sep 1984).

The first results of a Bevalac experiment on the range-energy (R-E) relation of Au beam nuclei, $E \leq 152$ MeV/amu, in CH and Au absorbers are reported. The measured ranges are found to agree, within $\sim +-2\%$, on the average, with those predicted by a R-E relation based on the phenomenology introduced by Barkas and Berger. The energy-loss rate and effective charge versus energy are also presented. The capability of the Bevalac for producing high-rigidity, low-charge-state beams applicable to heavy ion inertial fusion, and their planned use for range-energy experiments, is described.

25047 **(ORNL/FEDC—84/8) TFCX pumped limiter and vacuum pumping system design and analysis.** Haines, J.R. (Oak Ridge National Lab., TN (USA)). Apr 1985. Contract AC05-84OR21400. 62p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010450.

Impurity control system design and performance studies were performed in support of the Tokamak Fusion Core Experiment (TFCX) pre-conceptual design. Efforts concentrated on pumped limiter and vacuum pumping system design configuration, thermal/mechanical and erosion lifetime performance of the limiter protective surface, and helium ash removal performance. The reference limiter design forms a continuous toroidal belt at the bottom of the device and features a flat surface with a single leading edge. The vacuum pumping system features large vacuum ducts (diameter approximately 1 m) and high-speed, compound cryopumps. Analysis results indicate that the limiter/vacuum pumping system design provides adequate helium ash removal. Erosion, primarily by disruption-induced vaporization and/or melting, limits the protective surface lifetime to about one calendar year or only about 60 full-power hours of operation. In addition to evaluating impurity control system performance for nominal TFCX conditions, these studies attempt to focus on the key plasma physics and engineering design issues that should be addressed in future research and development programs.

25048 **(ORNL/Sub—84-95128/2) 140 GHz gyrotron development program. Quarterly report No. 2, July-September 1984.** Felch, K.L.; Bier, R.E.; Craig, L.J.; Fiddaman, T.S.; Fox, L.J.; Gaiser, B.D.; Hu, G.; Huey, H.E.; Ives, R.L.; Jory, H.R. (Varian Associates, Inc., Palo Alto, CA (USA)). 1984. Contract AC05-84OR21400. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE85010348.

The objective of this program is to develop a gyrotron oscillator capable of producing 100 kW of CW power at 140 GHz. Final calculations regarding the design of the first experimental tube are presented and an analysis pertaining to the important features of the second experimental tube are discussed. The design of two superconducting magnet configurations is included and further modifications to the design of various 140 GHz gyrotron components, diagnostics, and protective devices are listed.

25049 **(ORNL/TM—9542) Magnetics calculations for an ELMO Bumpy Square.** Santoro, R.T.; Uckan, N.A.; Schmitt, R.J. (Oak Ridge National Lab., TN (USA)). Mar 1985. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010442.

Calculations have been carried out to determine the vacuum magnetic parameters, forces, and the use of trim coils in an ELMO Bumpy Square. A configuration having five mirror coils per side and an eight-coil high-field toroidal solenoid corner assembly was studied. Favorable magnetic parameters are achieved in the device. An on-axis mirror ratio of 1.9, a global mirror ratio of 3.6, and excellent centering of plasma pressure contours are achieved. Particle losses are also minimal (<5%). The magnetic forces acting between coils are comparable with those encountered in the EBT-I/S magnet configuration. Circular trim coils were found to be suitable for restoring hot electron ring locations that are displaced when the coil currents are varied for performing magnetic studies or for assessing the effects on the EBS of the global mirror ratio.

25050 **(RIG—17) Status of neutronic investigation for fusion blanket design.** Rabitsch, H. (Verein zur Foerderung der Anwendung der Kernenergie, Graz (Austria). Reaktorinstitut). Jun 1984. 34p. (In German). NTIS (US Sales Only), PC A03/MF A01. File Number DE85700513.

This report gives a review of blanket concepts and methods for the determination of blanket parameters. Various studies and publications concerning neutronic analyses of blankets are cited. The conclusion of recent programs is a good agreement between measured results and theoretical calculations.

25051 **(SAND—84-2034) Tables of generalized hydrogen diffusion profiles and permeating fluxes for fusion applications.** Brice, D.K. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85008876.

Exact analytical solutions have been obtained for an approximate partial differential equation which describes the one-dimensional transport of hydrogen through a material layer having a uniform distribution of traps and with a thermal gradient. For application to a particular material and thermal gradient the validity of the approximations underlying the differential equation can be easily verified with a few simple calculations. The solutions are normalized by choosing appropriate depth (x) and time (t) scale factors and these generalized solutions are then found to be slowly varying functions of two dimensionless parameters rho, and z_0. The first parameter, rho, is a simple function of the activation energies for diffusion, E/sub D/, trapping, E/sub B/, and thermomigration, Q*. The parameter z_0 depends on E/sub D/, E/sub B/, and the temperatures at the two layer surfaces. Tables of the generalized diffusion profiles, G(ξ,tau), and permeating fluxes, J(tau), where $\xi = x/x_0$ and tau $= t/t_1$ are presented for a range of values of rho and z_0. With the aid of analytical results for the steady state, which are reported elsewhere but summarized here, these generalized solutions allow one to obtain diffusion profiles and permeating fluxes for many materials of interest in fusion applications and for a broad range of fusion reactor operating scenarios.

25052 **(SAND—84-2245) Development of a resistive load for PBFA II rimfire gas switch simultaneity and laser triggering tests.** Seamen, J.F. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85011080.

Before any useful energy can be delivered to the diode in PBFA II, all 36 rimfire gas switches have to be synchronized with a maximum jitter (one sigma) of 2 ns. In conjunction with the synchronization testing process, the laser system that will trigger all 36 rimfire gas switches will have to be aligned and tested. PBFA-I operations have also shown that being able to test gas switch performance without putting energy into the insulator stack or diode is very useful. Such a capability has been designed into PBFA II, with resistors that will manually be inserted across the first pulse-forming line (PFL1). A schematic of the equivalent circuit test setup and a schematic drawing of Demon are shown. The PFL1 resistors are designed to divert all energy away from the down-line water switches and diode load. The Demon accelerator, which is one module of PBFA II, was used to develop and test the resistive load. This paper describes those test results. 3 refs., 5 figs., 1 tab.

25053 **(UCID—20374) LINE: a code which simulates spectral line shapes for fusion reaction products generated by various speed distributions.** Slaughter, D. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE85010833.

A computer code is described which estimates the energy spectrum or "line-shape" for the charged particles and γ-rays produced by the fusion of low-z ions in a hot plasma. The simulation has several "built-in" ion velocity distributions characteristic of heated plasmas and it also accepts arbitrary speed and angular distributions although they must all be symmetric about the z-axis. An energy spectrum of one of the reaction products (ion, neutron, or γ-ray) is calculated at one angle with respect to the symmetry axis. The results are shown in tabular form, they are plotted graphically, and the moments of the spectrum to order ten are calculated both with respect to the origin and with respect to the mean.

25054 **(UCID—20403) Test cell modeling and optimization for FPD-II.** Haney, S.W.; Fenstermacher, M.E. (Lawrence Livermore National Lab., CA (USA)). 10 Apr 1985. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010836.

The Fusion Power Demonstration, Configuration II (FPD-II), will ba a DT burning tandem mirror facility with thermal bar-

riers, designed as the next step engineering test reactor (ETR) to follow the tandem mirror ignition test machines. Current plans call for FPD-II to be a multi-purpose device. For approximately the first half of its lifetime, it will operate as a high-Q ignition machine designed to reach or exceed engineering break-even and to demonstrate the technological feasibility of tandem mirror fusion. The second half of its operation will focus on the evaluation of candidate reactor blanket designs using a neutral beam driven test cell inserted at the midplane of the 90 m long cell. This machine called FPD-II+T, uses an insert configuration similar to that used in the MFTF-α+T study. The modeling and optimization of FPD-II+T are the topic of the present paper.

25055 **(UCRL—53604) Fragmentation of suddenly heated liquids.** Blink, J.A. (Lawrence Livermore National Lab., CA (USA)). Mar 1985. Contract W-7405-ENG-48. 350p. NTIS, PC A15/MF A01; GPO Dep. File Number DE85010773.

Thesis. Submitted to Univ. of California, Davis.

Fragmentation of free liquids in Inertial Confinement Fusion reactors could determine the upper bound on reactor pulse rate. The x-ray ablated materials must cool and recondense to allow driver beam propagation. The increased surface area caused by fragmentation will enhance the cooling and condensation rates. Relaxation from the suddenly heated state will move a liquid into the negative pressure region under the liquid-vapor P-V dome. The lithium equation of state was used to demonstrate that neutron-induced vaporization uses only a minor fraction of the added heat, much less than would be required to drive the expansion. A 77% expansion of the lithium is required before the rapid vaporization process of spinodal decomposition could begin, and nucleation and growth are too slow to contribute to the expansion.

25056 **(UCRL—53623) Research with high-power short-wavelength lasers.** Holzrichter, J.F.; Campbell, E.M.; Lindl, J.D.; Storm, E. (Lawrence Livermore National Lab., CA (USA)). 5 Mar 1985. Contract W-7405-ENG-48. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010329.

Three important high-temperature, high-density experiments were conducted recently using the 10-TW, short-wavelength Novette laser system at the Lawrence Livermore National Laboratory. These experiments demonstrated successful solutions to problems that arose during previous experiments with long wavelength lasers ($\lambda \geqq 1\mu m$) in which inertial confinement fusion (ICF), x-ray laser, and other high-temperature physics concepts were being tested. The demonstrations were: (1) large-scale plasmas (typical dimensions of up to 1000 laser wavelengths) were produced in which potentially deleterious laser-plasma instabilities were collisionally damped. (2) Deuterium-tritium fuel was imploded to a density of 20 g/cm^3 and a pressure of 10^{10} atm. (3) A 700-fold amplification of soft x rays by stimulated emission at 206 and 209 A (62 eV) from Se^{+24} ions was observed in a laser-generated plasma. Isoelectronic scaling to 155 A (87 eV) in Y^{+39} was also demonstrated.

25057 **(UCRL—90617) Magnetic ripple correction in tandem mirrors by ferromagnetic inserts.** Hamilton, G.W. (Lawrence Livermore National Lab., CA (USA)). 4 Apr 1985. Contract W-7405-ENG-48. 7p. (CONF-850310—56). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010042.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Magnetic ripple of 1% or more caused by discrete solenoid coils in the central cells of tandem mirrors may severely affect the MHD stability. The ripple amplitude can be reduced by an order of magnitude by ferromagnetic annuli inserted within the coils at the regions of ripple maxima. The inserts need not affect the accessibility, coil diameter, or capital cost, since large quantities of steel are required within the coils for the neutron blanket and shield. Design of the ripple correction is simplified and linearized by the cylindrical geometry and by the saturation of the ferromagnetic steel.

25058 **(UCRL—91646) Blanket optimization studies for Cascade.** Meier, W.R.; Morse, E.C. (Lawrence Livermore National Lab., CA (USA); California Univ., Berkeley (USA)). 28 Feb 1985. Contract W-7405-ENG-48. 7p. (CONF-850310—61). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010002.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

A nonlinear, multivariable, blanket optimization technique is applied to the Cascade inertial confinement fusion reactor concept. The thickness of a two-zone blanket, which consists of a BeO multiplier region followed by a $LiAlO_2$ breeding region, is minimized subject to constraints on the tritium breeding ratio, neutron leakage, and heat generation rate in Al/SiC tendons that support the chamber wall.

25059 **(UCRL—91648) ICF reactor economics: identifying the high leverage design features.** Meier, W.R.; Hogan, W.J. (Lawrence Livermore National Lab., CA (USA)). 28 Feb 1985. Contract W-7405-ENG-48. 8p. (CONF-850310—53). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010001.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Parametric studies were carried out for a heavy ion beam (HIB) fusion electric power plant to investigate the effects on the cost of electricity (COE) of variations in several design parameters. In particular, we examined the effects of maximum achievable chamber pulse rate, driver cost, target gain, electric conversion efficiency, and net electric power. We find that with a combination of improvements over our base case, HIB fusion can be economically competitive with other future power sources.

25060 **(UCRL—91876) Tokamak ignition/burn experimental research device.** Henning, C.D.; Logan, B.G.; Barr, W.L.; Bulmer, R.H.; Doggett, J.N.; Johnston, B.M.; Lee, J.D.; Hoard, R.W.; Slack, D.S.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 4 Apr 1985. Contract W-7405-ENG-48. 8p. (CONF-850310—52). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009999.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

As part of a continuing effort by the Office of Fusion Energy to define an ignition experiment, a superconducting tokamak has been designed with thin neutron shielding and aggressive magnet and plasma parameters. By so minimizing the inner radial dimensions of the tokamak center post, coil, and shielding region, the plasma major radius is reduced with a corresponding reduction in device costs. The peak nuclear-heating rate in the superconducting TF coils is 22 mW/cm^3, which results in a steady heat load to the cryogenic system of 50 kW. Fast-wave, lower-hybrid heating would be used to induce a 10-MA current in a moderate density plasma. Then pellet fueling would raise the density to achieve ignition as the current decays in a few hundred seconds. Steady-state current drive in subignited conditions permits a 0.8 MW/m^2 average wall loading to study plasma and nuclear engineering effects.

25061 **(UCRL—92019) New concept for pumping the edge plasma.** Barr, W.L. (Lawrence Livermore National Lab., CA (USA)). 4 Apr 1985. Contract W-7405-ENG-48. 3p. (CONF-850310—54). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010180.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

A new concept is proposed for pumped limiter designs that allows more flexibility and therefore better control of the edge plasma and its recycling at the limiter than previous designs.

25062 **(UCRL—92020) Modeling and optimization of operating parameters for a test-cell option of the Fusion Power Demonstration-II tandem mirror design.** Haney, S.W.; Fenstermacher, M.E. (Lawrence Livermore National Lab., CA (USA)). 3 Apr 1985. Contract W-7405-ENG-48. 7p. (CONF-850310—59). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009998.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Models of tandem mirror devices operated with a test-cell insert have been used to calculate operating parameters for FPD-II+T, an upgrade of the Fusion Power Demonstration-II device. Two test-cell configurations were considered, one accommodating two 1.5 m blanket test modules and the other having four. To minimize the cost of the upgrade, FPD-II+T utilizes the same coil arrangement and machine dimensions outside of the test cell as FPD-II, and the requirements on the end cell systems have been held near or below those for FPD-II. The maximum achievable test cell wall loading found for the short test-cell was 3.5 MW/m^2 while 6.0 MW/m^2 was obtainable in the long test-cell configuration. The most severe limitation on the achievable wall loading is the upper limit on test-cell beta set by MHD stability calculations. Modification of the shape of the magnetic field in the test-cell by improving the magnet design could raise this beta limit and lead to improved test-cell performance.

25063 **(UCRL—92021) Modeling and optimization of a test-cell upgrade for MFTF-B operating in the high neutron wall loading mode.** Fenstermacher, M.E. (Lawrence Livermore National Lab., CA (USA); TRW, Inc., Redondo Beach, CA (USA)). 3 Apr 1985. Contract W-7405-ENG-48. 8p. (CONF-850310—51). NTIS, PC A02/MF A01; GPO Dep. File Number DE85009997.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Models of the plasma particle and power balances in a tandem mirror with a high-field test-cell insert in the central cell have been used to calculate operating points for test-cell upgrades of the MFTF-B configuration. The code results have been benchmarked against the proposal plasma parameters for the MFTF-α+T configuration operating in the high neutron wall loading mode. Some parametric studies have been done. Using the results from these parametrics an optimized set of operating parameters for an MFTF-α+T-like configuration with a test-cell which will accommodate two 1.5 m long blanket test modules has been generated. This operating point has the same test-cell neutron wall loading as the original configuration and lower input powers to other systems in the device. The neutral beam power per unit blanket module length is also somewhat reduced in the optimized case.

25064 **(UCRL—92022) Plasma engineering models of tandem mirror devices with high-field test-cell inserts.** Fenstermacher, M.E.; Campbell, R.B. (Lawrence Livermore National Lab., CA (USA); TRW, Inc., Redondo Beach, CA (USA)). 3 Apr 1985. Contract W-7405-ENG-48. 7p. (CONF-850310—62). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010046.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

Plasma physics and engineering models of tandem mirror devices operated with a high-field technology test-cell insert in the central cell, which have been incorporated recently in the TMRBAR tandem mirror reactor physics code, are described. The models include particle and energy balance in the test-cell region as well as the interactions between the test-cell particles and those flowing through the entire device. The code calculations yield consistent operating parameters for the test-cell, central cell, and end cell systems. A benchmark case for the MFTF-α+T configuration is presented which shows good agreement between the code results and previous calculations.

25065 **(UCRL—92023) Plasma engineering for MINIMARS: a small commercial tandem mirror reactor with octopole plugs.** Perkins, L.J.; Logan, B.G.; Campbell, R.B. Devoto, R.S.; Blackfield, D.T.; Johnston, B.H. (Lawrence Livermore National Lab., CA (USA)). 3 Apr 1985. Contract W-7405-ENG-48. 6p. (CONF-850310—55). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010045.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

With the employment of a novel octopole end plug scheme, we examine the plasma engineering design of MINIMARS, a small compact fusion reactor based on the tandem mirror principle. With a net electric output of 600 MW/sub e/, MINIMARS is expressly designed for short construction times, factory built modules, and a passively safe blanket system. We show that the compact octopole/mantle provides several distinct improvements over the more conventional quadrupole (yin-yang) end plugs and enables ignition to be obtained with much shorter central cell length. In this way we can design economic small reactors which will minimize utility financial risk and provide attractive alternatives to the conventional larger fusion plants encountered to date.

25066 **(UCRL—92098) Physics-magnetics trade studies for tandem mirror reactors.** Campbell, R.B.; Perkins, L.J.; Blackfield, D.T. (Lawrence Livermore National Lab., CA (USA); Oak Ridge National Lab., TN (USA)). 1 Mar 1985. Contract W-7405-ENG-48. 7p. (CONF-850310—57). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010043.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

We describe and present results obtained from the optimization package of the Tandem Mirror Reactor Systems Code. We have found it to be very useful in searching through multidimensional parameter space, and have applied it here to study the effect of choke coil field strength and net electric power on cost of electricity (COE) and mass utilization factor (MUF) for MINIMARS type reactors. We have found that a broad optimum occurs at B/ sub choke/ = 26 T for both COE and MUF. The COE economy of scale approaches saturation at quite low powers, around 600 MW(e). The saturation is mainly due to longer construction times for large plants, and the associated time related costs. The MUF economy of scale does not saturate, at least for powers up to 2400 MW(e).

25067 **(UCRL—92344) Maximum current densities from tandem high density systems.** Hiskes, J.R.; Karo, A.M.; Willmann, P.A. (Lawrence Livermore National Lab., CA (USA)). 14 Mar 1985. Contract W-7405-ENG-48. 8p. (CONF-8503122—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE85008966.

From IAEA technical committee meeting on negative ion beam heating; Grenoble, France (20 Mar 1985).

The tandem high-density negative-ion-source system is optimized to identify the largest possible ion concentrations and extracted ion currents. The optimization includes varying the length of the second chamber, varying neutral gas and electron densities, and varying the ratio of atomic to molecular density. The electron excitation processes, e-V and E-V, are taken into account in the first chamber. Negative ions are formed through dissociative attachment in the second chamber.

25068 **(UCRL—92371) Design of aggressive superconducting TFCX magnet systems.** Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 29 Mar 1985. Contract W-7405-ENG-48. 10p. (CONF-850310—60). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010003.

From 6. topical meeting on the technology of fusion energy; San Francisco, CA, USA (3 Mar 1985).

An investigation of several fundamental limits of machine design indicate that a machine fitting the specifications of the Tokamak Fusion Core Experiment (TFCX) can be built with both a superconducting toroidal field (TF) coil set and a plasma major radius of less than 3.2 m. This small size is achieved by accepting a peak nuclear heat load of 50 (kW)(m^{-2}) in the TF coin inner leg while operating at a 10-T maximum field with a current density of 35 (A)(mm^{-2}) in the winding pack. This performance, high by traditional standards, is justified based on developments in forced flow conductor technology using Nb_3Sn composite superconductors.

25069 **Pressure induced islands in three-dimensional toroidal plasma.** Cary, J.R.; Kotschenreuther, M. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **28**: No. 5, 1392-1401(May 1985). Contract FG05-80ET53088.

The production of magnetic islands by plasma pressure in three-dimensional toroidal systems is analyzed. Far from the rational surfaces, a procedure based on linearization in the plasma pressure applies. This yields the solution in terms of δ-function currents at the surface. These currents are found by a nonlinear analysis

valid in the vicinity of the island. The result is a set of coupled nonlinear equations determining the island widths. Scaling is found by using the approximation of nearly circular flux surfaces. The results indicate that for typical stellarators, which have a small ratio ι_{total}/m_0 of field line rotational transform to coil rotational transform, the island size in the low-β limit depends dramatically on whether a magnetic well is present. In this case, if a magnetic well is present, islands are insignificant; in contrast, if a magnetic hill is present, island overlap occurs for arbitrarily low pressure.

25070 **Equilibrium of a liquid in a spherical shell caused by gravity, surface tension, and van der Waals forces.** Mok, L.S.; Kim, K.; Bernat, T.P. (Fusion Technology Laboratory, University of Illinois, Urbana, Illinois 61801). *Physics of Fluids;* **28**: No. 5, 1227-1232(May 1985). Contract FG02-81AF92002.

A rigorous proof is presented which shows that the classical Young—Laplace equation cannot predict a continuous liquid layer inside a spherical-shell container. An augmented Young—Laplace equation is in turn derived to describe the equilibrium profiles of a continuous liquid hydrogen layer inside a spherical-shell inertial fusion target. The augmentation is achieved by adding to the total free energy a term originating from the attractive intermolecular forces of the van der Waals type.

25071 **Opacity effects on hydrogen like x-ray lines emitted from laser-driven implosions.** Delamater, N.D.; Hooper C.F. Jr.; Joyce, R.F.; Woltz, L.A.; Ceglio, N.M.; Kauffman, R.L.; Lee, R.W.; Richardson, M.C. (University of Florida, Gainesville, Florida 32611). *Physical Review* [*Section*] *A: General Physics;* **31**: No. 4, 2460-2463(Apr 1985). Contract W-7405-ENG-48;AC08-80DP40124.

Glass microballoons filled with mixtures of argon and neon were imploded using the University of Rochester 24-beam Ω laser system. Experimentally observed Lyman-series x-ray lines were analyzed to determine plasma core parameters and the effects of opacity on spectroscopic diagnostics. The analysis produced results which were at odds with some previous assumptions.

99 GENERAL AND MISCELLANEOUS

25072 **(DOE/TIC/EGC—84/4) Energygrams: brief descriptions of energy technology.** Simpson, W.F. Jr. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). [1985]. 119p. (PB—84-903604). NTIS $8.00; GPO Dep. File Number TI85003786.

Available on a subscription basis at $30.00 per (calendar) year.

This is a quarterly compilation of technical notes published to transfer information and technology generated from DOE-sponsored research to identifiable audiences in industry, education, and federal, state, and local government. Energygrams are usually one-page illustrated bulletins describing DOE technology or data and telling how to obtain the technical reports, patent documents, software, or other material on which they are based. Frequently a personal contact is given who can provide program information in addition to the data found in the reports. The compilation is organized by subject categories, and within each category, by Energygram title.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 24280

25073 **(DOE/ER/10718—T1) Toolpack mathematical software development environment.** Osterweil, L. (Colorado Univ., Boulder (USA). Dept. of Computer Science). 21 Jul 1982. Contract AC02-80ER10718. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85011075.

The purpose of this research project was to produce a well integrated set of tools for the support of numerical computation. The project entailed the specification, design and implementation of both a diversity of tools and an innovative tool integration mechanism. This large configuration of tightly integrated tools comprises an environment for numerical software development, and has been named Toolpack/IST (Integrated System of Tools). Following the creation of this environment in prototype form, the environment software was readied for widespread distribution by transitioning it to a development organization for systematization, documentation and distribution. It is expected that public release of Toolpack/IST will begin imminently and will provide a basis for evaluation of the innovative software approaches taken as well as a uniform set of development tools for the numerical software community.

25074 **(DOE/ER/12046—T2) [Mathematics of surfaces]. Progress report.** Barnhill, R.E. (Utah Univ., Salt Lake City (USA). Dept. of Mathematics). Mar 1984. Contract AC02-82ER12046. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010439.

New research on the representation and approximation of three- and four-dimensional surfaces is summarized, and surface research has been collected and reviewed, with the goals of both understanding and using the subject. We have developed a suite of methods for the approximation and representation of three- and four-dimensional surfaces. These include triangular and tetrahedral interpolants and distance-weighted interpolants.

25075 **(DOE/ER/71030—T1) [Numerical algorithms for solving linear algebra problems]. Final report.** Golub, G.H. (Stanford Univ., CA (USA). Dept. of Computer Science). 16 Apr 1985. Contract AT03-76ER71030. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010310.

We have concentrated on developing and analyzing various numerical algorithms for solving problems arising in a linear algebra context. The papers and research fall into basically three categories: (1) iterative methods for solving linear equations arising from p.d.e.'s; (2) calculation of Gauss-type quadrature rules; and (3) solution of matrix and data problems arising in statistical computation. We summarize some of these results, highlighting those which are of most importance.

25076 **(K/CSD/TM—49) Extension to complex-valued functions of an algorithm for numerically inverting the Laplace transform.** Drake, J.B. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Mar 1985. Contract AC05-84OT21400. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE85010701.

A Fourier series method for numerically inverting the Laplace transform is described. The method has previously been analyzed only for real-valued functions. The method is extended to complex Fourier series and a complex-valued approximation. The analysis of the approximation is presented giving a bound for the error in discretization. Other types of errors are discussed and numerical results are presented. The sensitivity of the method to key parameters is documented and the error bound shown numerically to be very good. 10 refs., 5 figs.

25077 **(LA—10354-MS) Computing and Communications Division two-year operational plan, FY 1985-1986.** (Los Alamos National Lab., NM (USA)). Feb 1985. Contract W-7405-ENG-36. 221p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE85010571.

This report is an operational plan for the Computing and Communications Division of the Los Alamos National Laboratory for fiscal years 1985 and 1986. The objective of this plan is to provide Laboratory management, our users, and other interested people with information about our projects and associated schedules for implementation. Subjects discussed include planning considerations, network components, major hardware and software projects, direct user services, external activities, research and advanced development projects, and administration.

25078 **(SAND—85-0108) Lotus 1-2-3 based system reliability program.** Murphy, K.D. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1985. Contract AC04-76DP00789. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE85010533.

This report describes a Lotus 1-2-3 based system reliability computer program. The program uses 1-2-3's powerful macro capabilities to generate system reliability and graphic output in a user-

friendly, menu driven fashion. The program features: series connected, parallel connected, and k-of-n redundant parallel connected subsystem reliability calculations; and aggregate total system reliability calculations. The user enters component name, mean-time-before-failure (MTBF), and mean-time-to-repair (MTTR). The program calculates component failure rate and availability; subsystem MTBF, MTTR, and availability. Bar chart graphic presentation of component and system MTBF and availability are options through menu selections. The power of 1-2-3 is demonstrated by utilizing the integrated nature of the package i.e., calculative, database, and graphic operations. These techniques can be easily adopted for other applications.

25079 **(SOL—85-3) Dynamic programming approach to time-staged convex programs.** Scott, D.M. (Stanford Univ., CA (USA). Systems Optimization Lab.). Mar 1985. Contract AT03-76ER72018. 80p. NTIS, PC A05/MF A01; GPO Dep. File Number DE85010616.

This paper describes a dynamic programming-like technique for solving large scale (or at least moderately large scale) convex programs which have a time-staged (i.e., "staircase") structure. At the heart of the technique is a method for avoiding "the curse of dimensionality" which normally prevents the application of dynamic programming to problems whose time stages contain more than just a small number of variables. Three algorithms are developed: a "backward" algorithm, a "forward" algorithm, and a "time-symmetric" algorithm. The "backward" algorithm most closely resembles standard dynamic programming since "pricing" information propagates from the future back to the past. A strong connection is shown between these D.P.-like techniques and the "nested decomposition" algorithms of Manne and Ho, and Abrahamson and Wittrock, particularly the latter. These nested decomposition algorithms are used to solve "staircase linear programs" - a special case of the problem considered in this paper.

25080 **(UCID—20345) Scattered data interpolation codes.** Foley, T.A. (Lawrence Livermore National Lab., CA (USA)). 11 Feb 1985. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE85007337.

During the past decade, several scattered data interpolation codes have been developed that solve the following problem: given N points (x/sub i/,y/sub i/,z/sub i/), construct a smooth bivariate function F(x,y) that satisfies F(x/sub i/,y/sub i/) = z/sub i/ for i = 1,...,N. There appears to be no one code that will effectively solve this problem on all of the data sets encountered by this author. Some methods, such as Hardy's multiquadric method, work extremely well on smooth, accurate, and reasonably distributed data like those in Franke. However, this method is inefficient for large values of N and ineffective on some track data. The purpose of this report is to describe the set of subroutines available in INTER2V that will effectively handle most scattered data problems.

25081 **(UCRL—92360) Fast moving average recursive Least Mean Square Fit.** Ng, L.C.; LaTourette, R.A. (Lawrence Livermore National Lab., CA (USA); Naval Underwater Systems Center, New London, CT (USA)). 13 Mar 1985. Contract W-7405-ENG-48. 6p. (CONF-851209—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE85010036.

From 24. IEEE conference on decision and control; Ft. Lauderdale, FL, USA (11 Dec 1985).

A new approach is developed to reduce the computational complexity of a moving average Least Mean Square Fit (LMSF) procedure. For a long data window, a traditional batch approach would result in a large number of multiplication and add operations (i.e., an order N, where N is the window length). This study shows that the moving average batch LMSF procedure could be made equivalent to a recursive process with identical filter memory length but at an order of reduction in computational load. The increase in speed due to reduced computation make the moving average LMSF procedure competitive for many real time processing applications. Finally, this paper will also address the numerical accuracy and stability of the algorithm. 4 refs., 1 fig.

25082 **First digit phenomenon and ergodic theory.** Robertson, J.B.; Uppuluri, V.R.R.; Rajagopal, A.K. (Univ. of California, Santa Barbara). *Journal of Mathematical Analysis and Applications;* 95: No. 2, 375-378(Sep 1983). Contract W-7405-ENG-26.

For any k belongs to I^+ identical with the set of positive integers, let S(k) denote the set of positive integers beginning with k, i.e., S(k) = {n: k = (n/10/sup r/) for some r belongs to I^+}, where (x) denotes the greatest integer less than or equal to x. Consider some finitely additive extension of the density function d(S) = (lim/n → infinity) [S intersection (1, N)]/N, where S contains or equals I^+ and (S) denotes the cardinality of S. If d(k) = d(S(k)) is defined for all positive integers K, and if the mapping T that maps S into (2S) union (2S + 1) preserves the density d, then the result of Cohen is that d(p) = $\log_{10}$ (1 + (1/p)) for p belongs to D. The crucial step here is the specific relation of the transformation T to the multiplication of the elements of S by 2. This motivates us to consider the following problem: Set b = 10 and let a belongs to R^+ be a positive real number. Let theta (x) = ax, where x belongs R^+, and consider the sequence p = (p_1, p_2,...) of first digits of the orbit of theta: {x, theta(x), $theta^2$ (x), ...}. That is p/sub k/ = (theta /sup k/ (x)/b/sup r/) belongs to D where r = ($\log_{10}$ theta/sup k/ (x)). The purpose of this paper is to investigate the dynamical properties of the sequence p. 7 references.

25083 **Adding statistics routines to the SLATEC public domain subprogram library.** Durst, M.J.; Margolies, D.S.; Fong, K. (Lawrence Livermore National Lab., CA). *Statistical Computing Section Proceedings of the American Statistical Association;* 42-44(1983). Contract W-7405-ENG-48.

The SLATEC library is a public-domain portable library of FORTRAN subroutines organized by several DOE and DOD laboratories. SLATEC includes a comprehensive set of mathematical routines, including special functions, linear algebra, and differential equation solvers. These routines will run on most computers which support FORTRAN. It was decided to include statistical routines in SLATEC, and some routines are being added. This paper discusses the nature of SLATEC, indicate plans for the statistics routines, and call for further contributions to SLATEC.

9903 Information Handling

25084 (CONF-830669—, pp 149-164) **Climate information products for energy applications: long-range forecasts and current data products.** Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

Information about current and planned Climate Analysis Center products of potential value in energy applications is discussed and presented in summary form.

25085 (CONF-830669—, pp 165-184) **Climate data and information provided by the National Climatic Data Center.** Doty, S.R. (National Oceanic and Atmospheric Administration, Asheville, NC). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

The National Climatic Data Center (NCDC) is tasked with maintaining and providing climatic data and information. Situated in downtown Asheville, NC the NCDC has three major data sets of interest to the energy community. These data, hourly, daily, and monthly, are available on microfiche, on magnetic tape, in paper copies, and in publications. Most data are available 45-60 days after the end of the data month; historically, some of these data go back as far as the early 1900s. NCDC's mission and its three major data sets are described, and the process and sources through which the data are available are outlined.

25086 (CONF-830669—, pp 185-215) **Weather-energy assessment products of the Assessment and Information Services Center.** Hadeen, K.D.; Warren, H.E. (National Oceanic and Atmospheric Administration, Washington, DC). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

The Assessment and Information Services Center (AISC) within the National Environmental Satellite, Data, and Information Service (NESDIS) is the lead National Oceanic and Atmospheric Administration (NOAA) organization responsible for determining, assessing, and reporting the social and economic impacts of climate anomalies and weather events on various sectors of the economy. An important component of these assessments is energy. AISC obtains current weather data products from the Climate Analysis Center (CAC) and historical data products from the National Climatic Data Center (NCDC). AISC then uses these meteorological observational data, and monthly and seasonal outlook data from the National Weather Service with other multidiscipline and economic data to derive short-term impact assessment products. These impact assessment products are produced on weekly, biweekly, and monthly intervals with annual summaries and special reports as required.

25087 (CONF-830669—, pp 216-232) **Climatological analyses and tailored products.** Quinlan, F.T. (National Oceanic and Atmospheric Administration, Asheville, NC). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

Climatological analyses and tailored products enable the energy industry to make more realistic decisions regarding services and supplies. The heating degree day, one such product, was developed over 50 years ago to estimate the amount of fuel used by home furnaces. It is shown that population-weighted heating degree data provide estimates of extreme heating fuel demand and how simple seasonal temperature departures are used to describe the variety of past regional climate patterns. Such information is required to assure that fuel distribution and storage systems are designed to provide sufficient heating fuel supplies.

25088 (CONF-830669—, pp 233-241) **Long-range forecasting: the present and the future.** Gilman, D.L. (National Oceanic and Atmospheric Administration, Washington, DC). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

The basis for current long-range forecasts of the NOAA Climate Analysis Center is described as a framework for speculating on research directions that are most likely to lead to improvements in forecast accuracy.

25089 (CONF-830669—, pp 242-251) **Remarks on the potential for long-range forecasting.** Namias, J. (Scripps Institution of Oceanography, La Jolla, CA). Jul 1984. NTIS, PC A12/MF A01. File Number DE85001471.

From DOE/industry workshop on the interactions of climate and energy; Harpers Ferry, WV, USA (6 Jun 1983).

This paper, originally delivered as a lecture before the DOE-sponsored Workshop on Climate and Energy, offers some comments on the state-of-the-art of long range weather forecasting based on the author's extensive decades of experience. An optimistic note is made on the potential ability to predict general climate anomalies from months to perhaps a year or so in advance, and implies that extreme conditions impacting energy industries may be easier to forecast than run-of-the-mill events. Highly detailed predictions beyond a week or two are not expected to be achievable, however.

25090 **(DOE/TIC—4500-Rev.74) Instructions and category scope notes. Revision 74.** (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Apr 1985. 28p. NTIS, PC $8.75/MF A01; GPO Dep. File Number DE85007913.

This document contains the subject category Scope Notes used for the distribution of both hard copy reports and microfiche. Also included is each category's specified print run (noted in the Table of Contents) for contractors who provide OSTI printed copies of reports to disseminate to currently authorized standard distribution addresses. The number designates how many printed copies are required by OSTI to carry out the official distribution of scientific and technical reports to authorized standard distribution recipients.

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Title, (supplementary information), citation number, (R;US)

The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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$\approx\theta\cong\sigma\sqrt{\int}'_{3}\mu\ \Sigma\mu_{\pi\sigma}\rightleftharpoons$
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AC03-84BC99880	**National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)**	
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	Harvard Univ., Cambridge, MA (USA)	
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	Sandia National Labs., Albuquerque, NM (USA)	
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	10:23637	SAND—85-0946C
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	Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering	
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	Sandia National Labs., Albuquerque, NM (USA)	
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	10:23861	NUREG/CR—3721/1
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	Argonne National Lab., IL (USA)	
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AC04-76DP03533	**Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant**	
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AC04-76DR00789	**Austrian Solar and Space Agency, Vienna**	
	10:23647	DOE/DR/00789—T109
	Sandia National Labs., Livermore, CA (USA)	
	10:23648	SAND—83-8019
	McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)	
	10:23649	SAND—84-8186
	Boeing Engineering and Construction Co., Seattle, WA (USA)	
	10:23692	SAND—81-8188
	Sandia National Labs., Livermore, CA (USA)	
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AC05-84OT21400	**Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.**	
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AC06-76RL01830	**Pacific Northwest Labs., Richland, WA (USA)**	
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AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
	10:23530	EGG-TIO-M—00685
	10:23548	EGG-M—02585
	10:23549	EGG-M—07885
	10:23712	EGG-M—08485
	10:23800	EGG-EA—6749
	10:23852	EGG-RST—6833
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	Sandia National Labs., Albuquerque, NM (USA)	
	10:24274	SAND—84-1520
	Idaho National Engineering Lab., Idaho Falls (USA)	
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AC07-82ID12399	**Mechanical Technology, Inc., Latham, NY (USA)**	
	10:23986	MTI—84/TR/4
AC07-83ID12461	**American Planning Association, Chicago, IL**	
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AC08-76EV00703	**Univ. of Hawaii, Honolulu**	
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AC08-81NV10174	**Louisiana Geological Survey, Baton Rouge (USA)**	
	10:23713	DOE/NV/10174—4
AC08-82NV10250	**Westinghouse Electric Corp., Mercury, NV (USA). Waste Technology Services Div.**	
	10:23542	DOE/NV/10250—18
AC09-76SR00001	**Bechtel National, Inc., San Francisco, CA (USA). Advanced Technology Div.**	
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	Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.	
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AC21-79ET15457	**General Electric Co., Schenectady, NY (USA). Advanced Energy Programs Dept.**	
	10:23453	DOE/ET/15457—1632
AC21-80ET17093	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center**	
	10:23415	DOE/ET/17093—1741
AC21-82MC19122	**Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.**	
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AC21-82MC19163	**Scientific Design Co., Inc., New York (USA)**	
	10:23388	DOE/MC/19163—1789
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AC21-83MC20333	**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**	
	10:23455	DOE/MC/20333—1670
AC21-84MC21147	**Radian Corp., Austin, TX (USA)**	
	10:23416	DOE/MC/21147—T1
AC22-77ET10679	**Engineering Societies Commission on Energy, Inc., Washington, DC (USA)**	
	10:23383	DOE/ET/10679—T36
AC22-81PC40267	**Combustion Engineering, Inc., Windsor, CT (USA). Power Systems Group**	
	10:23460	DOE/PC/40267—5
AC22-81PC40272	**Solar Turbines, Inc., San Diego, CA (USA)**	
	10:23746	DOE/PC/40272—8

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AC22-84PC70002	**UOP, Inc., Des Plaines, IL (USA). Process Div.**	
	10:23392	DOE/PC/70002—T1
AC79-82BP36734	**Oregon Dept. of Geology and Mineral Industries, Portland (USA)**	
	10:23701	DOE/BP—272
AI01-76ET20320	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
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AI01-77ET20342	**Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.**	
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AI01-79ET23077	**Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology**	
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AI01-81CS66001	**Jet Propulsion Lab., Pasadena, CA (USA)**	
	10:24239	CONF-8310201—4
AI05-84ER13230	**National Bureau of Standards, Washington, DC (USA)**	
	10:23489	DOE/ER/13230—T1
AI08-76DP00474	**Geological Survey, Albuquerque, NM (USA). Water Resources Div.**	
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AI21-82MC19350	**Harry Diamond Labs., Adelphi, MD (USA)**	
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AM03-76SF00034	**Univ. of California, Los Angeles**	
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AS05-76ER05223	**Texas A and M Univ., College Station (USA). Dept. of Physics**	
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AS05-77ER05489	**National Bureau of Standards, Washington, DC**	
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AS05-78OR06021	**Florida State Univ., Tallahassee (USA)**	
	10:24443	DOE/OR/06021—1
AS05-79ER10427	**Physics Department, Brookhaven National Laboratory, Upton, New York 11973**	
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AS05-79ER10448	**Institute of Field Physics, Department of Physics and Astronomy, University of North Carolina, Chape**	
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AS05-79ER10459	**Louisiana State Univ., Baton Rouge**	
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AS08-83DP40191	**California Univ., Davis (USA). Dept. of Applied Science**	
	10:25025	DOE/DP/40191—1
AS08-84DP40194	**Yale Univ., New Haven, CT (USA). Dept. of Applied Physics**	
	10:25026	DOE/DP/40194—1
AS19-80BC10326	**State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering**	
	10:23472	DOE/BC/10326—10
AS20-80LC10449	**Wyoming Univ., Laramie (USA). Wyoming Water Research Center**	
	10:23509	DOE/LC/10449—1762
AS20-83LC11010	**Colorado State Univ., Fort Collins (USA)**	
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AT01-76CH93028	**National Academy of Sciences - National Research Council, Washington, DC (USA). Geophysics Research Board**	
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AT01-79CS10047	**Energy and Environmental Policy Center, Cambridge, MA (USA)**	
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AT03-76ER70227	**Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, Cal**	
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AT06-70ER73019	Washington Univ., Seattle (USA). Dept. of Botany	
	10:24401	DOE/ER/73019—T1
AT19-81BC10476	Oklahoma Univ., Norman (USA). Dept. of Chemistry	
	10:24166	DOE/BC/10476—12
AT21-79MC12837	Physical Sciences, Inc., Woburn, MA (USA)	
	10:23939	DOE/MC/12837—1761
FC01-78RG08086	Washington Univ., Seattle (USA)	
	10:23963	DOE/RG/08086—T1
FC01-80RG10506	Ebasco Business Consulting Co., New York (USA)	
	10:23924	DOE/RG/10506—T1
FC05-77ET10069	Exxon Research and Engineering Co., Florham Park, NJ (USA)	
	10:23381	DOE/ET/10069—T112
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	10:23382	DOE/ET/10069—T113
FC07-79ID12026	Maine Univ., Orono (USA). Dept. of Geological Sciences	
	10:23703	DOE/ID/12026—T10
FC21-83FE60181	North Dakota Univ., Grand Forks (USA). Energy Research Center	
	10:23384	DOE/FE/60181—139
	10:23454	DOE/FE/60181—136
FC21-84MC21136	New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center	
	10:23475	DOE/MC/21136—4
FG01-77CS20469	United Planning Organization, Washington, DC (USA)	
	10:23961	DOE/CS/20469—T1
FG01-78ET13134	Miami Univ., Coral Gables, FL (USA). Dept. of Mechanical Engineering	
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FG01-78ET20023	California Univ., Riverside (USA). Dept. of Soil and Environmental Sciences	
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FG01-79CS20241	Gilbert/Commonwealth, Reading, PA (USA)	
	10:23983	DOE/CS/20241—T1
	United Engineers and Constructors, Inc., Philadelphia, PA (USA)	
	10:23993	DOE/CS/20241—T2
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36077	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009823	MN -34	10:24813
36080	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009769	MN -28	10:24217
36088	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010544	MN -28	10:24256
36091	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009763	MN -23	10:24273
36218	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010231	MN -28	10:24251
36274	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85010549	MN -90i	10:23465
CBPF-MO-				
001/ 82	NTIS (US Sales Only), PC A05/MF A01	DE85700449	MN -34D	10:24840
CBPF-NF-				
021/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700495	MN -34A	10:24825
025/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700470	MN -34D	10:24708
033/ 82	NTIS (US Sales Only), PC A03/MF A01	DE85700496	MN -34A	10:24826
035/ 82	NTIS (US Sales Only), PC A03/MF A01	DE85700485	MN -34A	10:24546
046/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700497	MN -34A	10:24455
048/ 82	NTIS (US Sales Only), PC A03/MF A01	DE85700462	MN -34D	10:24841
CE-Trans-				
7660	NTIS (US Sales Only), PC A02/MF A01; 1	DE85901342	MN -41	10:23872
7900	NTIS (US Sales Only), PC A02; 1	DE85901145	MN -37	10:24196
7946	NTIS (US Sales Only), PC A02/MF A01; 1	DE85901147	MN -79p	10:23873
7970	NTIS (US Sales Only), PC A03/MF A01; 1	DE85901141	MN -25	10:24142
CEA-N-				
2396	NTIS (US Sales Only), PC A09/MF A01	DE85901311	MN -34C	10:24742
CEGB-RD/B-				
5200/ N84	NTIS (US Sales Only), PC A06/MF A01	DE85700899	MN -23	10:24312
CERN-				
84-09	NTIS (US Sales Only), PC A25/MF A01	DE85700841	MN -34D	10:24630
CONF-790622-	(2. international pulsed power conference, Lubbock, TX, USA, 12-14 Jun 1979)			
	NTIS, PC A22/MF A01; 1 (GPO Dep.)	E 1.99: DE85000613	MN -21	10:24942
CONF-7907129-	(UCLA small-scale hydro resources development western regional workshop, Pomona, CA, USA, 30 Jul-1 Aug 1979)			
	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE84005144	MN -97e	10:23602
CONF-790913-	(54. annual SPE technical conference and exhibition, Las Vegas, NV, USA, 23-26 Sep 1979)			
	Soc. Pet. Eng. AIME, Pap., No. SPE-8449, vp(1979)			10:23404
	Soc. Pet. Eng. AIME, Pap., No. SPE-8395, vp(1979)			10:23506
CONF-791233-	(Conference on thermal performance of the exterior envelopes of buildings, Orlando, FL, USA, 3-5 Dec 1979)			
	See ASHRAE/SP-28	DE83014620	MN -95d	10:23942
CONF-8009327-	(Shipboard energy conservation '80 symposium, New York, NY, USA, 22-23 Sep 1980)			
	Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048	TI84009461	ND -96	10:23977
Suppl.	Society of Naval Architects and Marine Engineers, 1 World Trade Center, Suite 1369, New York, NY 10048	TI84009462	ND -96	10:23978
CONF-8010382-	(Morocco/United States oil shale colloquium, Rabat, Morocco, 1 Oct 1980)			
	See DOE/METC-84-23	E 1.99: DE84009251	STD -91	10:23502
CONF-8103193-	(International Energy Agency conference on pyranometer measurements, Boulder, CO, USA, 16-20 Mar 1981)			
	See SERI/TR-642-1156	E 1.99: DE85000082	MN -59A	10:23611
CONF-810545-	(3. conference on waste heat management and utilization, Miami, FL, USA, 12 May 1981)			
	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99: DE84009374	MN -95e	10:23981
CONF-8106339-	(Symposium on dynamics and management of Mediterranean-type ecosystems, San Diego, CA, USA, 22-26 Jun 1981)			
	See PSW-58	E 1.99: DE85011082	MN -11	10:24309
CONF-8112113-	(9. NIRS environmental seminar on study of tritium behavior in environment and human body, Chiba, Japan, 22 Sep 2517,-4 Dec 1981)			
	See NIRS-M-42	DE85780802	MN -11	10:24325
CONF-820442-	(American Nuclear Society regional student conference, Atlanta, GA, USA, 16-17 Apr 1982)			
Absts.	*See* DOE/ER/10275-1C	DE83004082	MN -2	10:23839
CONF-8205297-	(Workshop on nuclei far from stability, Tanashi, Tokyo, Japan, 31 May-2 Jun 1982)			
	See INS-NUMA-44	DE85780870	MN -34D	10:24788
CONF-8206114-	(47. Cold Spring Harbor symposium - quantitative biology, Cold Spring Harbor, NY, USA, 2-9 Jun 1982)			
Pt.1	Cold Spring Harbor Laboratory, Box 100, Cold Spring Harbor, NY 11724	TI83015606	ND -48	10:24333
CONF-8206274-	(Workshop on advanced diagnostic techniques for the combustion of coal and coal derived fuels, Pittsburgh, PA, USA, 28-30 Jun 1982)			
	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE85008212	MN -90e	10:23442
CONF-820892-	(Oil Shale Task Force conference, Vail, CO, USA, 9-12 Aug 1982)			
	Publications Center, Golden, CO 80401			10:23512

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CONF-820929-	(IUPAP international conference on magnetism, Kyoto, Japan, 6-10 Sep 1982)				
15	*See* CBPF-NF-021/82		DE85700495	MN -34A	10:24825
CONF-8211201-	(Workshop on hyper nuclear physics, Oho, Ibaraki, Japan, 25-27 Nov 1982)				
	See KEK-83-6		DE85700863	MN -34C	10:24806
CONF-830342-	(US/Japan 3-D MHD workshop, Nagoya, Japan, 8-11 Mar 1983)				
	See IPPJ-632		DE85780869	MN -20	10:24921
CONF-8303103-	(International symposium on renewable energy sources, Lahore, Pakistan, 18-22 Mar 1983)				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008378	MN -64	10:23654
CONF-8303183-	(7. workshop on the mass of the electron neutrino, Oho, Ibaraki, Japan, 24 Mar 1983)				
	See KEK-83-15		DE85700854	MN -34D	10:24623
CONF-830460-	(19. annual meeting of the National Council of Radiation Protection and Measurements, Washington, DC, USA, 6-7 Apr 1983)				
	No. 5, 261-263(1 Nov 1983)				10:23587
	No. 5, 40-82(1 Nov 1983)				10:24316
	No. 5, 38-39(1 Nov 1983)				10:24415
CONF-830485-	(64. annual American Welding Society meeting, Philadelphia, PA, USA, 24-29 Apr 1983)				
	Weld. Res. Suppl., 346s-355s(Dec 1983)				10:24069
CONF-830511-	(6. international symposium on salt, Toronto, Canada, 24-28 May 1983)				
3	*See* SERI/TP-255-2001	E 1.99:	DE85009873	MN -62	10:23651
CONF-830588-	(Delta-Nucleus dynamics symposium, Argonne, IL, USA, 2-4 May 1983)				
	See ANL-PHY-83-1	E 1.99:	DE84003655	MN -34C	10:24794
CONF-8305246-	(Meeting on fast monochromatic neutrons and their interdisciplinary use, Tanashi, Tokyo, Japan, 30 May 1983)				
1	*See* INS-TS-22		DE85700873	MN -34C	10:23589
CONF-8305258-	(Symposium on new techniques and potential applications in ultrasenaitive mass spectrometry, Washington, DC, USA, 31 May 1983)				
Summ.	NTIS, PC A03/MF A01; 1		DE85009043	MN -34A	10:24257
CONF-8305260-	(Conference on radioactivity in drinking water, Easton, MD, USA, 23-26 May 1983)				
1	NTIS, PC A05; 3		DE85009702	MN -41	10:24402
CONF-8307126-	(3. annual summer school on high energy accelerators, Upton, NY, USA, 6-16 Jul 1983)				
	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008891	MN -28	10:24247
CONF-830939-	(Waterpower '83 - international conference on hydropower, Knoxville, TN, USA, 18-21 Sep 1983)				
Vol.1	*See* TVA/PUB-84/21a	E 1.99:	DE84007682	MN -97e	10:23606
Vol.2	*See* TVA/PUB-84/21b	E 1.99:	DE84008049	MN -97e	10:23605
Vol.3	*See* TVA/PUB-84/21c	E 1.99:	DE84007687	MN -97e	10:23607
CONF-8309206-	(National wind energy conference, Noordwijkerhout, Netherlands, 14-16 Sep 1983)				
1	*See* NLR-MP-83054-U			ND -60	10:23732
2	*See* NLR-MP-83055-U			ND -60	10:23733
CONF-8310110-	(Conference on families and energy: coping with uncertainty, East Lansing, MI, USA, 9-11 Oct 1983)				
	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE85000086	MN -95d	10:23959
CONF-8310201-	(Combustion Institute fall meeting of the western states section, Los Angeles, CA, USA, 17-18 Oct 1983)				
4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010018	MN -95f	10:24239
CONF-8310360-	(Conference on problem of many bodies in nuclear physics, Leningrad, USSR, 4-6 Oct 1983)				
1	*See* ITEF-124(1983)		DE85700870	MN -34C	10:24803
CONF-8310376-	(Nordic seminar regarding seasonal storage of heat, Goeteborg, Sweden, 5-6 Oct 1983)				
	See BFR-R-21-1984		DE85751422	MN -94e	10:23876
CONF-8310377-	(Building Research Council seminar on environmental effects from natural heat collecting systems, Aspenaesgaarden, Sweden, 24-25 Oct 1983)				
	See BFR-R-60-1984		DE85751427	MN -95	10:24308
CONF-8310378-	(Symposium on energy technology for policy makers, Linkoeping, Sweden, 17-18 Oct 1983)				
	NTIS (US Sales Only), PC A21/MF A01; 1		DE85751430	MN -98	10:23886
CONF-831142-	(Automotive technology development contractor coordination meeting, Dearborn, MI, USA, 13-17 Nov 1983)				
	NTIS, PC A18/MF A01; 1 (GPO Dep.)	E 1.99:	DE85000072	MN -96	10:23995
CONF-8311148-	(Workshop on borehole measurements and interpretation in scientific drilling: identification of problems and proposals for their solution, Albuquerque, NM, USA, 15-17 Nov 1983)				
	See SAND-84-0288	E 1.99:	DE84010626	MN -66b	10:23716

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CONF-831204-	(2. Mid-Atlantic energy conference and exposition, Baltimore, MD, USA, 6-8 Dec 1983)			
	Government Institutes, Inc., 966 Hungerford Dr., No. 24, Rockville, MD 20850	TI84013400	ND -95	10:23958
CONF-840192-	(7. annual symposium in botany - structure, function and biosynthesis of plant cell walls, Riverside, CA, USA, 12-14 Jan 1984)			
	American Society of Plant Physiologists, P.O. Box 1688, Rockville, MD 20850	TI85009403	ND -48	10:24392
CONF-8402143-	(Symposium on geothermal energy for New Zealand's future, Rotorua, New Zealand, 1 Feb 1984)			
1	*See* HNEI-84-S01	DE85901283	MN -66	10:23714
CONF-8402144-	(Conference on Bergson and modern science, Galveston, TX, USA, 8-10 Feb 1984)			
1	*See* LBL-19145	E 1.99: DE85009961	MN -34D	10:24893
CONF-8403130-	(4. topical workshop on proton antiproton collider physics, Bern, Switzerland, 5-8 Mar 1984)			
	See CERN-84-09	DE85700841	MN -34D	10:24630
CONF-8405236-	(7. symposium on elementary particle physics, Kazimierz, Poland, 21-25 May 1984)			
3	*See* RAL-84-075	DE85700842	MN -34D	10:24685
CONF-8405299-	(Workshop on radiative processes, Vancouver, Canada, 4-5 May 1984)			
1	*See* DOE/ER/40048-07-N4	E 1.99: DE85007812	MN -34D	10:24649
CONF-8406198-	(Design and utilization of the superconducting super collider summer study, Snowmass, CO, USA, 23 Jun-13 Jul 1984)			
43	*See* FNAL/C-85/54-T	E 1.99: DE85010096	MN -34D	10:24650
CONF-8406234-	(International symposium on phase transitions in the very early universe, Bielefeld, F.R. Germany, 1 Jun 1984)			
1	*See* FNAL/C-84/119-A	E 1.99: DE85003948	MN -34B	10:24480
CONF-8406241-	(Conference on high performance textiles structures, Philadelphia, PA, USA, 6-8 Jun 1984)			
1	*See* N-85-12095			10:23997
CONF-8406246-	(Conference on the evolution of American environmental politics, Washington, DC, USA, 28-29 Jun 1984)			
	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99: DE85007859	MN -11	10:23898
CONF-840786-	(9. international conference on atomic physics, Seattle, WA, USA, 23-27 Jul 1984)			
5	*See* UCRL-92336	E 1.99: DE85009858	MN -34A	10:24223
CONF-840804-	(Intersociety energy conversion engineering conference, San Francisco, CA, USA, 19-24 Aug 1984)			
	Proc., Intersoc. Energy Convers. Eng. Conf., 2: 1219-1225(Aug 1984)			10:23399
	Proc., Intersoc. Energy Convers. Eng. Conf., 2: 1258-1265(Aug 1984)			10:23400
	Proc., Intersoc. Energy Convers. Eng. Conf., 2: 1234-1242(Aug 1984)			10:23749
CONF-840805-	(188. meeting of the American Chemical Society, Philadelphia, PA, USA, 26-31 Aug 1984)			
28	*See* LBL-18281	E 1.99: DE85009940	MN -93A	10:23940
CONF-840848-	(42. annual Electron Microscopy Society of America meeting, Detroit, MI, USA, 13-17 Aug 1984)			
10	*See* LBL-17552	E 1.99: DE85009959	MN -25	10:24277
CONF-840879-	(17. international conference on the physics of semiconductors, San Francisco, CA, USA, 6-10 Aug 1984)			
13	*See* LBL-17530	E 1.99: DE85009939	MN -25	10:24112
CONF-840956-	(Executive conference on the decontamination of power plant reactors--costs, benefits, and consequences, Springfield, MA, USA, 16-19 Sep 1984)			
1	*See* PNL-SA-12562	E 1.99: DE85010054	MN -70	10:23775
CONF-8409163-	(Workshop on coherent and collective propagation of relativistic E-beams and electromagnetic radiation, Villa Olmo, Como, Italy, 13-16 Sep 1984)			
4	*See* BNL-36080	E 1.99: DE85009769	MN -28	10:24217
CONF-8409219-	(2. international workshop on atomic physics for ion fusion, Chilton, UK, 11-14 Sep 1984)			
1	*See* LBL-19031	E 1.99: DE85009958	MN -21	10:25046
CONF-841005-	(Instrumentation for heavy ion nuclear research conference, Oak Ridge, TN, USA, 22-26 Oct 1984)			
12	*See* LBL-19096	E 1.99: DE85009945	MN -34C	10:24269
CONF-841007-	(Nuclear science symposium, Orlando, FL, USA, 31 Oct-2 Nov 1984)			
63	*See* LBL-17780	E 1.99: DE85009944	MN -37	10:24268
CONF-8410179-	(DOE geothermal technology conference, El Centro, CA, USA, 16-19 Oct 1984)			
	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE85008202	STD -66	10:23699
CONF-8410207-	(Conference on corrosion chemistry within pits, crevices and cracks, Teddington, UK, 1-3 Oct 1984)			
2	*See* PNL-SA-12315	E 1.99: DE85010059	MN -25	10:24030

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CONF-8410210-	(7. high energy heavy ion study conference, Darmstadt, F.R. Germany, 8-13 Oct 1984)				
12	*See* LBL-19114	E 1.99:	DE85009941	MN -34C	10:24808
CONF-8410222-	(American Physical Society meeting, Santa Fe, NM, USA, 31 Oct-3 Nov 1984)				
19	*See* SLAC-PUB-3589	E 1.99:	DE85010537	MN -34D	10:24625
CONF-8410234-	(Application of geochemical models to high-level nuclear waste repository assessment, Oak Ridge, TN, USA, 2-5 Oct 1984)				
Summa.	*See* NUREG/CP-0062		TI85009817	MN -70	10:23557
CONF-8410235-	(Old and new problems in fundamental physics meeting (in honor of G. C. Wick), Pisa, Italy, 25-26 Oct 1984)				
2	*See* LBL-19200		DE85009931	MN -34D	10:24875
CONF-8410256-	(Workshop on scientific opportunities with advanced facilities for neutron scattering, Shelter Island, NY, USA, 23-26 Oct 1984)				
1	*See* LA-UR-85-783	E 1.99:	DE85009594	MN -37	10:24267
CONF-841157-	(Materials Research Society annual meeting, Boston, MA, USA, 26-29 Nov 1984)				
88	*See* BNL-35988	E 1.99:	DE85009822	MN -25	10:24003
89	*See* UCRL-91779	E 1.99:	DE85010041	MN -25	10:24036
90	*See* PNL-SA-12940	E 1.99:	DE85010051	MN -70	10:23563
CONF-841202-	(Symposium on thermal insulation, materials and systems, Dallas, TX, USA, 2-6 Dec 1984)				
2	*See* LBL-17591	E 1.99:	DE85009943	MN -95d	10:23979
CONF-841210-	(International chemical congress of Pacific Basin Society, Honolulu, HI, USA, 16-21 Dec 1984)				
22	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009704	MN -4	10:24185
23	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010251	MN -70	10:23537
CONF-841264-	(Black liquor research program symposium, Washington, DC, USA, 12 Dec 1984)				
	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010244	STD -95f	10:23982
CONF-850110-	(International conference on neutron scattering in the '90s, Juelich, F.R. Germany, 14-18 Jan 1985)				
6	*See* BNL-36077	E 1.99:	DE85009823	MN -34	10:24813
CONF-850122-	(9. annual conference on composites and advanced ceramic materials and workshop on testing methods for ceramic matrix composites, Cocoa Beach, FL, USA, 20-24 Jan 1985)				
7	*See* SAND-84-2375C	E 1.99:	DE85010094	MN -25	10:24100
CONF-850123-	(American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting, Chicago, IL, USA, 27-31 Jan 1985)				
3	*See* LBL-18025	E 1.99:	DE85009960	MN -95d	10:23966
CONF-850128-	(2. international workshop on laser acceleration of particles, Los Angeles, CA, USA, 7-18 Jan 1985)				
8	*See* SLAC-PUB-3572	E 1.99:	DE85009846	MN -28	10:24254
9	*See* BNL-36091	E 1.99:	DE85009763	MN -23	10:24273
10	*See* SAND-85-0494C	E 1.99:	DE85009436	MN -28	10:24248
11	*See* LA-UR-85-883	E 1.99:	DE85009548	MN -28	10:24219
12	*See* SLAC-PUB-3629	E 1.99:	DE85010536	MN -28	10:24249
13	*See* SLAC-PUB-3601	E 1.99:	DE85010538	MN -28	10:24255
14	*See* BNL-36218	E 1.99:	DE85010231	MN -28	10:24251
CONF-850142-	(Arizona State University centennial symposium on high-resolution electron microscopy, Tempe, AZ, USA, 7-11 Jan 1985)				
5	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010270	MN -25	10:24275
CONF-850152-	(3. LEAR workshop, Tignes-Savoie, France, 19-26 Jan 1985)				
3	*See* LA-UR-85-1060	E 1.99:	DE85009627	MN -34	10:24704
CONF-850168-	(Colloquium on firing technology and environmental protection, Cologne, F.R. Germany, 24 Jan 1985)				
1	*See* TVA/PE/FHP-85/4		DE85901206	MN -90i	10:23422
CONF-850169-	(7. international conference on positron annihilation, New Delhi, India, 6-11 Jan 1985)				
1	*See* UCRL-92289	E 1.99:	DE85008958	MN -34A	10:24037
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010286	MN -25	10:24004
6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010267	MN -25	10:24005
CONF-850252-	(Solar thermal research program annual conference, Denver, CO, USA, 20-22 Feb 1985)				
3	*See* SAND-84-0627C	E 1.99:	DE85008405	MN -62b	10:23633
CONF-850276-	(NO/sub x/ symposium - international operational experience, Karlsruhe, F.R. Germany, 21-22 Feb 1985)				
	NTIS (US Sales Only), PC A99/MF A01; 1		DE85770255	MN -90i	10:23753
CONF-850301-	(12. annual energy technology conference and exposition, Washington, DC, USA, 25-27 Mar 1985)				
4	*See* SERI/TP-251-2671	E 1.99:	DE85000514	MN -62c	10:23650
CONF-850306-	(Solar energy conference--1985, Knoxville, TN, USA, 25-29 Mar 1985)				
2	*See* SERI/TP-252-2569	E 1.99:	DE85000534	MN -62a	10:23697
CONF-850310-	(6. topical meeting on the technology of fusion energy, San Francisco, CA, USA, 3-7 Mar 1985)				
18-Rev.	*See* LA-UR-85-513-Rev.	E 1.99:	DE85009585	MN -20d	10:25041

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46	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009740	MN -20c	10:24006
47	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009673	MN -20a	10:25016
48	*See* LA-UR-85-748	E 1.99: DE85009590	MN -21	10:25043
49	*See* LA-UR-85-747	E 1.99: DE85009589	MN -21	10:25042
50	*See* LA-UR-85-790	E 1.99: DE85009571	MN -21	10:25044
51	*See* UCRL-92021	E 1.99: DE85009997	MN -20d	10:25063
52	*See* UCRL-91876	E 1.99: DE85009999	MN -20f	10:25060
53	*See* UCRL-91648	E 1.99: DE85010001	MN -21	10:25059
54	*See* UCRL-92019	E 1.99: DE85010180	MN -20a	10:25061
55	*See* UCRL-92023	E 1.99: DE85010045	MN -20	10:25065
56	*See* UCRL-90617	E 1.99: DE85010042	MN -20d	10:25057
57	*See* UCRL-92098	E 1.99: DE85010043	MN -20d	10:25066
59	*See* UCRL-92020	E 1.99: DE85009998	MN -20d	10:25062
60	*See* UCRL-92371	E 1.99: DE85010003	MN -20f	10:25068
61	*See* UCRL-91646	E 1.99: DE85010002	MN -21	10:25058
62	*See* UCRL-92022	E 1.99: DE85010046	MN -20a	10:25064
64	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85010503	MN -20d	10:25017
65	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010496	MN -20	10:25018
66	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010495	MN -20b	10:25019
67	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010502	MN -20d	10:25020
68	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010497	MN -20f	10:25021
69	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010494	MN -20b	10:25022
CONF-850314-	(Waste management '85, Tucson, AZ, USA, 24-28 Mar 1985)			
40	*See* UCRL-91740	E 1.99: DE85009449	MN -70	10:23569
45	*See* EGG-TIO-M-00685	E 1.99: DE85009972	MN -71	10:23530
48	*See* PNL-SA-12649	E 1.99: DE85010055	MN -70	10:23562
50	*See* PNL-SA-12545	E 1.99: DE85010050	MN -70	10:23561
51	*See* EGG-M-02585	E 1.99: DE85009678	MN -70B	10:23548
52	*See* EGG-M-07885	E 1.99: DE85009679	MN -70B	10:23549
56	*See* PNL-SA-12663	E 1.99: DE85010304	MN -85	10:23532
CONF-850343-	(SOLERAS - workshop on solar applications in rural locations, Las Cruces, NM, USA, 11-14 Mar 1985)			
1	*See* SAND-85-0556C	E 1.99: DE85009837	MN -62b	10:23678
CONF-850345-	(Southwest conference on optics, Albuquerque, NM, USA, 4-8 Mar 1985)			
9	*See* LA-UR-85-1028	E 1.99: DE85009621	MN -37	10:24276
11	*See* LA-UR-85-1133	E 1.99: DE85009610	MN -28	10:24252
12	*See* LA-UR-85-1097	E 1.99: DE85009603	MN -4	10:24180
13	*See* SAND-85-0545C	E 1.99: DE85009409	MN -38	10:24244
14	*See* SAND-84-2016C	E 1.99: DE85010070	MN -34A	10:24222
15	*See* SAND-84-1974C	E 1.99: DE85010072	MN -45	10:24287
CONF-850351-	(30. international gas turbine conference and exhibit, Houston, TX, USA, 18-21 Mar 1985)			
5	NTIS, PC A02; 3	DE85009737	MN -93	10:24228
6	American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017	T185901384	MN -25	10:24007
CONF-850357-	(Spring national meeting of AIChE, Houston, TX, USA, 24-28 Mar 1985)			
9	*See* LA-UR-85-1062	E 1.99: DE85009628	MN -25	10:24001
CONF-850388-	(Solar buildings: realities for today - trends for tomorrow, Washington, DC, USA, 18-20 Mar 1985)			
1	*See* SERI/TP-253-2672	E 1.99: DE85000516	MN -59A	10:23679
6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010271	MN -59A	10:23682
CONF-8503103-	(2. international conference on acid rain, Washington, DC, USA, 26-27 Mar 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010281	MN -90i	10:23414
CONF-8503113-	(Eastern simulation conference, Norfolk, VA, USA, 3-8 Mar 1985)			
1	*See* UNI-SA-135	E 1.99: DE85008435	MN -80	10:23803
CONF-8503122-	(IAEA technical committee meeting on negative ion beam heating, Grenoble, France, 20-22 Mar 1985)			
1	*See* UCRL-92344	E 1.99: DE85008966	MN -21	10:25067
CONF-8503123-	(Ignition design point workshop, Princeton, NJ, USA, 12 Mar 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009507	MN -20	10:25024
CONF-8503124-	(SPIE symposium on microlithography, Santa Clara, CA, USA, 10-15 Mar 1985)			
1	*See* SAND-84-1956C	E 1.99: DE85007608	MN -4	10:24181
CONF-8503126-	(5. general conference of the Condensed Matter Division of the European Physical Society, Berlin, F.R. Germany, 18-22 Mar 1985)			
1	*See* LBL-19254	E 1.99: DE85009967	MN -25	10:24148
CONF-850405-	(2. national topical meeting on tritium technology in fission, fusion and isotopic applications, Dayton, OH, USA, 30 Apr-2 May 1985)			
2	*See* DP-MS-84-101	E 1.99: DE85008258	MN -80	10:23836
5	*See* LA-UR-85-982	E 1.99: DE85009635	MN -20d	10:25045
CONF-850408-	(6. European photovoltaic solar energy conference and exhibition, London, UK, 15-19 Apr 1985)			
1	*See* SAND-85-0951C	E 1.99: DE85010119	MN -63	10:23638
2	*See* SAND-84-2002C	E 1.99: DE85010120	MN -63	10:23635
3	*See* SAND-85-0946C	E 1.99: DE85010389	MN -63	10:23637

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CONF-850419-	(21. annual meeting of the National Council on Radiation Protection and Measurements, Washington, DC, USA, 3-4 Apr 1985)			
1	*See* PNL-SA-12970	E 1.99: DE85010058	MN -70	10:23564
CONF-850421-	(2. spring meeting of the Materials Research Society, San Francisco, CA, USA, 15-18 Apr 1985)			
1	*See* SAND-84-2365C	E 1.99: DE85010092	MN -25	10:24120
2	*See* SAND-84-2308C	E 1.99: DE85010091	MN -25	10:24119
CONF-850441-	(Moisture and humidity symposium, Washington, DC, USA, 15-18 Apr 1985)			
3	*See* LBL-17774	E 1.99: DE85009957	MN -95d	10:23965
CONF-850471-	(Workshop on methods for assessing the off-site radiological consequences of nuclear accidents, Luxembourg, Luxembourg, 15-19 Apr 1985)			
1	*See* SAND-85-0884C	E 1.99: DE85009712	MN -80	10:23870
CONF-850494-	(American Society of Civil Engineers spring meeting, Denver, CO, USA, 29 Apr-3 May 1985)			
2	*See* DP-MS-85-8	E 1.99: DE85009488	MN -70	10:23545
CONF-850530-	(7. international symposium on coal slurry fuels preparation and utilization, New Orleans, LA, USA, 21-24 May 1985)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85010608	MN -90b	10:23406
CONF-850565-	(13. biennial lignite symposium on technology and use of low-rank coals, Bismarck, ND, USA, 21-23 May 1985)			
3	*See* DOE/FE/60181-136	E 1.99: DE85010357	MN -90	10:23454
CONF-850573-	(Topical conference on basic properties of optical materials, Gaithersburg, MD, USA, 7-9 May 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009743	MN -34A	10:24008
CONF-850578-	(DOE/BES contractors' combustion meeting, Lake Geneva, WI, USA, 22-24 May 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009716	MN -4	10:24190
CONF-850582-	(31. ISA international instrumentation symposium, San Diego, CA, USA, 6-9 May 1985)			
7	*See* UCRL-91609	E 1.99: DE85008955	MN -37	10:24206
CONF-8505123-	(ASMS annual conference on mass spectrometry and applied topics, San Diego, CA, USA, 26-31 May 1985)			
1	*See* DOE/ER/10689-5	E 1.99: DE85009478	MN -4	10:24167
CONF-850606-	(American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting, Honolulu, HI, USA, 23-27 Jun 1985)			
1	*See* LBL-18062	DE84016877	MN -95d	10:23967
CONF-850610-	(Annual meeting of the American Nuclear Society, Boston, MA, USA, 9-14 Jun 1985)			
25	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009037	MN -20	10:24896
26	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009505	MN -20	10:25023
CONF-850683-	(Symposium on the foundations of modern physics, Joensuu, Finland, 16-20 Jun 1985)			
1	*See* SLAC-PUB-3537	E 1.99: DE85008179	MN -34D	10:24687
CONF-8506107-	(Society of Women Engineers conference, Minneapolis, MN, USA, 27-30 Jun 1985)			
2	*See* SAND-85-0050C	E 1.99: DE85009759	MN -70	10:23568
CONF-850706-	(8. international symposium on detonation, Albuquerque, NM, USA, 15-19 Jul 1985)			
13	*See* UCRL-92420	E 1.99: DE85010038	MN -45	10:24288
CONF-850801-	(International symposium on geothermal energy, Kailua Kona, HI, USA, 26-30 Aug 1985)			
27	*See* EGG-M-08485	E 1.99: DE85009885	MN -66g	10:23712
CONF-850809-	(8. international conference on structural mechanics in reactor technology, Brussels, Belgium, 19-23 Aug 1985)			
43	*See* PNL-SA-13000	TI85010049	MN -78	10:23782
CONF-850841-	(Workshop on coupling symbolic and numeric computation in expert systems, Bellevue, WA, USA, 27-29 Aug 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85007944	MN -80	10:23815
CONF-850942-	(190. American Chemical Society national meeting, Chicago, IL, USA, 8-13 Sep 1985)			
7	*See* DOE/FE/60181-139	E 1.99: DE85009963	MN -90	10:23384
CONF-851209-	(24. IEEE conference on decision and control, Ft. Lauderdale, FL, USA, 11-13 Dec 1985)			
2	*See* UCRL-92360	E 1.99: DE85010036	MN -32	10:25081
COO-				
2218-313	*See* CONF-850610-25	E 1.99: DE85009037	MN -20	10:24896
2218-315	*See* CONF-850610-26	E 1.99: DE85009505	MN -20	10:25023
CRPE-NT-				
134	*See* N-85-14720			10:24542
CSIR-RR-				
559	NTIS (US Sales Only), PC A07/MF A01	DE85700879	MN -4	10:24144
CTH-A-				
84-136	*See* STEV-FBA-84-21	DE85751441	MN -90e	10:23462

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202-1	Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.		ND -92a	10:23470
202-2	Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg, Germany, F.R.		ND -92a	10:23471
DOE/AL/24085-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009918	MN -34C	10:24744
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10	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85000129	STD -92a	10:23472
DOE/BC/10476-				
12	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85000124	STD -92a	10:24166
DOE/BC/99880-				
7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009342	MN -92	10:23488
DOE/BP-				
272	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE85008052	MN -66f	10:23701
391	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99: DE85009855	MN -11	10:23901
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0023/ 4	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85010970	STD -95	10:23902
0105	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85001509	MN -98D	10:23608
DOE/CE/40539-				
02	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85010455	STD -95f	10:24240
DOE/CE/64780-				
T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010612	MN -95	10:23960
DOE/CE/76245-				
1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85000210	STD -97a	10:23771
DOE/CH-				
6(2) App.C-D	NTIS, PC A25/MF A01	DE85008285	MN -11	10:24464
DOE/CH/93028-				
T1	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85010115	MN -11	10:24465
DOE/CP/11915-				
1	Synergy Inc., 2337 Eighteenth Street, NW, Washington, DC 20009	TI85010205	ND -98C	10:23486
DOE/CS/10047-				
T10	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85008900	MN -98B	10:23478
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T1	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE85010204	MN -95f	10:23983
T2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85010607	MN -95e	10:23993
DOE/CS/20469-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85010200	MN -95d	10:23961
DOE/CS/40531-				
T2	NTIS, PC A10/MF A01 (GPO Dep.)	E 1.99: DE85010811	MN -95f	10:23984
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T1	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85010133	MN -61D	10:23596
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1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010202	MN -21	10:25025
DOE/DP/40194-				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85010199	MN -20g	10:25026
DOE/DR/00789-				
T109	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85009355	MN -62a	10:23647
DOE/EIA-				
0035(85/ 01)	NTIS, PC A07/MF A01 - GPO (GPO Dep.)	E 1.99: DE85009599	MN -98	10:23931
0109(85/ 02)	NTIS, PC A06/MF A01 - GPO (GPO Dep.)	E 1.99: DE85010606	MN -98B	10:23479
0121(84/ 4Q)	NTIS, PC A05/MF A01 - GPO (GPO Dep.)	E 1.99: DE85010008	MN -98A	10:23433
0130(85/ 02)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	E 1.99: DE85010480	MN -98C	10:23493
0384(84)	NTIS, PC A12/MF A01 - GPO (GPO Dep.)	E 1.99: DE85010696	MN -98	10:23917
0468	NTIS, PC A04/MF A01 - GPO (GPO Dep.)	E 1.99: DE85010469	MN -98A	10:23434
M006	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011523	MN -98	10:23918
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0045/ 13	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE85010454	STD -20c	10:25027
0224	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99: DE85010320	STD -20	10:24894
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T8	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE85010229	MN -25	10:24082
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30	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85008684	MN -34D	10:24614
DOE/ER/03935-				
92	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010338	MN -25	10:24022
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69	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010440	MN -34C	10:24750
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T1	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE85010311	MN -13	10:23903
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T13	NTIS, PC A02; 3 (GPO Dep.)	E 1.99: DE85011085	MN -63	10:23617
T15	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011087	MN -90d	10:23380
T16	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85011089	MN -63	10:23618
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T1	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99: DE85008107	MN -13	10:23904
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1C	NTIS, PC A05/MF A01; 1	DE83004082	MN -2	10:23839
DOE/ER/10430-				
T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE85010299	MN -25	10:24023
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T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009453	MN -90b	10:23435
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5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009478	MN -4	10:24167

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
DOE/ER/10716-004	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010146	MN -28	10:24265
DOE/ER/10718-T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85011075	MN -32	10:25073
DOE/ER/12042-3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010441	MN -4	10:24184
DOE/ER/12044-2	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE85010300	MN -25	10:24083
DOE/ER/12046-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010439	MN -32	10:25074
DOE/ER/13126-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010297	MN -4	10:24168
DOE/ER/13131-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010515	MN -4	10:24158
DOE/ER/13163-T2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85005654	MN -38	10:24084
DOE/ER/13230-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010768	MN -4	10:23489
DOE/ER/13273-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010399	MN -48	10:24400
DOE/ER/13282-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010154	MN -4	10:24191
DOE/ER/40048-07-N4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85007812	MN -34D	10:24649
DOE/ER/45113-1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008372	MN -38	10:24024
DOE/ER/45126-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010400	MN -25	10:24085
DOE/ER/45144-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010447	MN -34D	10:24710
DOE/ER/53154-77	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010182	STD -20f	10:24899
DOE/ER/60098-1-Vol.1	Cold Spring Harbor Laboratory, Box 100, Cold Spring Harbor, NY 11724		TI83015606	ND -48	10:24333
DOE/ER/60215-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010162	MN -4	10:23408
DOE/ER/71030-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010310	MN -32	10:25075
DOE/ER/73019-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009141	MN -48	10:24401
DOE/ET/10069-T112	NTIS (US Sales Only), PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007014	STD -90d	10:23381
T113	NTIS (US Sales Only), PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010394	STD -90d	10:23382
DOE/ET/10679-T36	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010379	MN -90	10:23383
DOE/ET/13077-104	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85000123	STD -92a	10:23473
107	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010398	MN -92a	10:23474
DOE/ET/15457-1632	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85003248	STD -90h	10:23453
DOE/ET/17019-20-Vol.1	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008743	STD -93A	10:23937
20-Vol.2	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008742	STD -93A	10:23938
DOE/ET/17093-1741	NTIS, PC A25/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007168	STD -90i	10:23415
DOE/ET/20023-T1	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010048	MN -61A	10:23619
DOE/ET/27111-T6	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009787	MN -66	10:23702
DOE/ET/34034-110	NTIS, PC A05/MF A01; 1		DE85008235	MN -77	10:23793
DOE/ET/37240-109-PR	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010336	MN -79	10:23799
DOE/ET/53088-143	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010401	MN -20	10:24900
170	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85010114	MN -20a	10:24901
173	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010084	MN -20g	10:24902
DOE/EV/02725-T4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010298	MN -48	10:24403
DOE/EV/04703-45	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010061	MN -34A	10:24547
DOE/FE/60181-136	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010357	MN -90	10:23454
139	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009963	MN -90	10:23384
DOE/FE/60457-1	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE85009751	STD -90j	10:23920
DOE/ID/01570-T95	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009815	MN -20	10:25037
DOE/ID/12026-T10	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010256	MN -66a	10:23703

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DOE/JPL/956406-1	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE85006110	STD -63b	10:23620
DOE/LC/10449-1762	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99: DE85003373	STD -91	10:23509
DOE/LC/11010-1772	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99: DE85003381	STD -90c	10:23385
DOE/LLW-42T	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85010412	STD -70B	10:23541
DOE/MC/12837-1761	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85003371	STD -90g	10:23939
DOE/MC/19122-1810	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99: DE85010517	STD -90c	10:23386
1811	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85011063	STD -90c	10:23387
DOE/MC/19163-1789	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99: DE85003392	STD -90c	10:23388
1790	NTIS, PC A20/MF A01 (GPO Dep.)	E 1.99: DE85003393	STD -90c	10:23389
DOE/MC/19350-1760	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85003372	STD -90	10:23390
DOE/MC/20333-1670	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85001086	STD -90f	10:23455
DOE/MC/21136-4	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE85010683	MN -92a	10:23475
DOE/MC/21147-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008562	MN -90i	10:23416
DOE/METC-84-23	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99: DE84009251	STD -91	10:23502
85/ 2007	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008600	MN -90e	10:23745
DOE/METC/SP-208	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85001982	STD -92	10:23497
217	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85001985	STD -92a	10:23491
DOE/NASA/20320-62	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010012	STD -60	10:23724
DOE/NBM-5007889	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85007889	MN -64	10:23656
DOE/NE-0048/ 8	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE85010433	STD -80	10:23774
DOE/NV/10174-4	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85010462	MN -66a	10:23713
DOE/NV/10250-18	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85008391	MN -70	10:23542
DOE/OR/06021-1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85010343	MN -48	10:24443
DOE/OR/20722-5-Add.1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE85010531	STD -70A	10:23543
DOE/OR/21400-T111	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010127	MN -90	10:23391
DOE/OT/21400-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010575	MN -22	10:23521
DOE/PC/30215-5	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85010079	MN -90e	10:23456
T2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85010080	MN -90e	10:23457
DOE/PC/30229-7	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85010688	STD -90a	10:24169
DOE/PC/40267-5	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE85010673	STD -90a	10:23460
DOE/PC/40272-8	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE85008002	STD -90e	10:23746
DOE/PC/40283-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85010157	MN -4	10:24192
DOE/PC/50790-T7	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85007808	STD -90a	10:23409
DOE/PC/60807-6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85007005	MN -90a	10:23490
DOE/PC/70002-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010145	MN -90d	10:23392
DOE/PC/70774-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008703	MN -90d	10:23410
DOE/PC/70782-3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011097	MN -90a	10:23411
DOE/PC/70785-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008847	MN -90d	10:23591
DOE/PC/70787-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008656	MN -90d	10:23393
DOE/PE/70411-T1-Pts.1and2	NTIS PC $75.00/MF A01 (includes Pts. 1, 2, and diskette)	TI85009027	ND -95a	10:23975
DOE/R3/02402-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009176	MN -63	10:23643
DOE/R3/02406-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009178	MN -59B	10:23659
DOE/R3/02427-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE85009269	MN -59B	10:23660
DOE/R3/02433-T1	NTIS, PC A03; 3	DE85008984	MN -60	10:23725

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
DOE/R3/02434-T1	NTIS, PC A02; 3		DE85009265	MN -59A	10:23661
DOE/R3/02445-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008497	MN -59B	10:23962
DOE/R3/02449-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009413	MN -59A	10:23683
DOE/R3/02450-T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE85009412	MN -59B	10:23662
DOE/R3/02451-T1	NTIS, PC A02; 3		DE85009411	MN -59B	10:23663
DOE/R3/02454-T1	NTIS, PC A04; 3		DE85009689	MN -59B	10:23615
DOE/R3/02455-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009330	MN -59A	10:23664
DOE/R3/06045-T1	NTIS, PC A02; 3		DE85009149	MN -59A	10:23684
DOE/R3/06050-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009218	MN -59B	10:23665
DOE/R3/06051-T1	NTIS, PC A02; 3		DE85009203	MN -59A	10:23666
DOE/R3/06052-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009735	MN -60	10:23726
DOE/R3/06057-T1	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE85009259	MN -59A	10:23685
DOE/R3/06061-T1	NTIS, PC A06; 3		DE85009246	MN -59A	10:23667
DOE/R3/06064-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009215	MN -59A	10:23668
DOE/R3/06065-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009216	MN -59A	10:23669
DOE/R3/06067-T1	NTIS, PC A06; 3		DE85010165	MN -59B	10:23670
DOE/R3/06068-T1	NTIS, PC A02; 3		DE85009156	MN -59A	10:23686
DOE/R3/06072-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009423	MN -60	10:23727
DOE/R3/06074-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009197	MN -59B	10:23687
DOE/R3/06076-T1	NTIS, PC A04; 3		DE85009195	MN -59A	10:23688
DOE/R3/06095-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009191	MN -59A	10:23689
DOE/R3/06104-T1	NTIS, PC A03; 3		DE85009151	MN -60	10:23728
DOE/R3/06114-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009243	MN -59B	10:23671
DOE/R3/08061-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009485	MN -95f	10:23985
DOE/R3/08068-T1	NTIS, PC A04; 3		DE85009205	MN -60	10:23672
DOE/R3/08073-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009160	MN -58	10:23673
DOE/R3/08079-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009390	MN -59B	10:23674
DOE/R3/08088-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009251	MN -59A	10:23690
DOE/R3/08091-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009483	MN -59A	10:23675
DOE/R3/08098-T1	NTIS, PC A03; 3		DE85009381	MN -59A	10:23676
DOE/R3/08105-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009378	MN -95f	10:24197
DOE/R3/08106-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009387	MN -59A	10:23677
DOE/R5/10197-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010421	MN -95	10:23941
DOE/RA/50276-T2	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85009544	MN -97	10:23742
T3	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009347	MN -97	10:23743
DOE/RG/08086-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010312	MN -95d	10:23963
DOE/RG/10506-T1	NTIS, PC A13/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010339	MN -95a	10:23924
DOE/RW-0025	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010971	MN -70	10:23544
DOE/SF/10754-T4	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010424	MN -32	10:23851
DOE/SF/11445-4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85000126	STD -92a	10:23476
DOE/SF/12218-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009864	MN -90j	10:23436
DOE/TIC-4500-Rev.74	NTIS PC $8.75/MF A01 (GPO Dep.)	E 1.99:	DE85007913	MN -2	10:25090

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DOE/TIC/EGC-				
84/ 4	NTIS$8.00 (GPO Dep.)	E 1.99: TI85003786	ND -13	10:25072
DP-MS-				
84-101	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85008258	MN -80	10:23836
85-8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009488	MN -70	10:23545
DPSPU-				
83-124-3	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85010222	MN -71	10:24198
DPST-				
82-319	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010066	MN -70	10:23546
84-439	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85010063	MN -70	10:23547
E-				
2339	*See* N-85-12095			10:23997
ECN-				
85-032	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	10:23729
85-033	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	10:23730
85-048	ECN, P.O. Box 1, 1755 ZG Petten, The Netherlands		ND -60	10:23720
EEB-L-				
85-01	*See* LBL-19035	E 1.99: DE85010626	STD -95	10:23970
EEB-Vent-				
84-22	*See* LBL-18025	E 1.99: DE85009960	MN -95d	10:23966
EFN-LET-				
1983-06	NTIS (US Sales Only), PC A03/MF A01	DE85751447	MN -58	10:23609
EGG-				
2245	*See* NUREG/CR-3193	TI85009331	MN -78	10:24229
EGG-EA-				
6749	NTIS, PC A02/MF A01 - GPO	TI85008937	MN -78	10:23800
EGG-M-				
02585	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009678	MN -70B	10:23548
07885	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009679	MN -70B	10:23549
08485	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009885	MN -66g	10:23712
EGG-RST-				
6833	NTIS, PC A03/MF A01	TI85010130	MN -78	10:23852
EGG-TIO-M-				
00685	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009972	MN -71	10:23530
EPA-				
600/ 2-85/ 040	*See* ORNL/TM-9317	E 1.99: DE85010578	MN -95e	10:24321
EPRI-AP-				
3932	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI85920597	ND -90f	10:23747
EPRI-CS-				
3914	NTIS, PC A06/MF A01 - Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 $13.00 (GPO Dep.)	E 1.99: DE85009024	MN -37	10:23748
3936	NTIS, PC A07/MF A01 - Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303 (GPO Dep.)	E 1.99: DE85010837	MN -90i	10:23417
3952	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI85920592	ND -90d	10:23418
EPRI-EA-				
3793	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $14.50	TI85920547	ND -97	10:23925
EPRI-EM-				
3943	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI85920582	ND -95d	10:23911
EPRI-NP-				
3832	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $16.00	TI85920566	ND -78	10:23780
3873	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $20.50	TI85920563	ND -78	10:23802
3933	Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303, $11.50	TI85920576	ND -70B	10:23550
ERP/CRL-				
83-16(R)	NTIS (US Sales Only), PC A02/MF A01; 1	DE84901632	MN -88	10:23424
83-20(R)	NTIS (US Sales Only), PC A02/MF A01	DE84901633	MN -90i	10:23437
ESC-				
29	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98E	10:23887
ESC-WR-				
84-20	ECN, PO Box 1, 1755 ZG Petten, The Netherlands		ND -98	10:23926
85-01	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -98	10:23888
85-04	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -60	10:23717
85-06	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -95	10:23912
85-09	ECN, P.O. Box 1, 1755 ZG Petten, Netherlands		ND -95	10:23913
EUR-				
8691-EN	Commission of the European Communities, Luxembourg		ND -85	10:24199
9170-EN	Commission of the European Communities, Luxembourg		ND -13	10:23889
9178-EN	Commission of the European Communities, Luxembourg		ND -13	10:23890
9238-EN	Commission of the European Communities, Luxembourg		ND -95d	10:23891
9269-EN	Commission of the European Communities, Luxembourg		ND -95	10:23914
9404-DE	Commission of the European Communities, Luxembourg		ND -90e	10:24241

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9407-EN	Commission of the European Communities, Luxembourg		ND -89	10:23394
9440-EN	Commission of the European Communities, Luxembourg		ND -61	10:23590
9473-EN	Commission of the European Communities, Luxembourg		ND -90a	10:23412
FE-				
2468-115	*See* DOE/ET/10679-T36	E 1.99: DE85010379	MN -90	10:23383
2893-133	*See* DOE/ET/10069-T112	E 1.99: DE85007014	STD -90d	10:23381
2893-152	*See* DOE/ET/10069-T113	E 1.99: DE85010394	STD -90d	10:23382
FEI-				
1366	NTIS (US Sales Only), PC A02/MF A01	DE85700860	MN -46	10:24814
1413	NTIS (US Sales Only), PC A02/MF A01	DE85700822	MN -34A	10:24827
1425	NTIS (US Sales Only), PC A02/MF A01	DE85700548	MN -34C	10:24773
1426	NTIS (US Sales Only), PC A02/MF A01	DE85700789	MN -34D	10:24843
1427	NTIS (US Sales Only), PC A02/MF A01	DE85700823	MN -34A	10:24086
1443	NTIS (US Sales Only), PC A02/MF A01	DE85700820	MN -34A	10:24548
1451	NTIS (US Sales Only), PC A02/MF A01	DE85700861	MN -46	10:24815
1456	NTIS (US Sales Only), PC A02/MF A01	DE85700868	MN -34C	10:24795
1458	NTIS (US Sales Only), PC A02/MF A01	DE85700862	MN -34C	10:24796
FES-				
75-79-Vol.2	NTIS, PC A19; 3	DE85010087	MN -97	10:23770
FFA-REPORT-				
136	NTIS (US Sales Only), PC A05/MF A01	DE85751434	MN -60	10:23731
FFA-TN-				
1984-48	*See* STEV-VIND-84-34	DE85751444	MN -60	10:23722
FNAL/C-				
84/ 119-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85003948	MN -34B	10:24480
85/ 17-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009536	MN -34B	10:24481
85/ 54-T	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85010096	MN -34D	10:24650
FRP-				
82/ 6	NTIS (US Sales Only), PC A04/MF A01	DE85700883	MN -25	10:23789
82/ 7	NTIS (US Sales Only), PC A03/MF A01	DE85700884	MN -25	10:23790
FTD-ID(RS)T-				
0311-84	*See* N-85-13224			10:24221
GAO/RCED-				
85-17	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20877	TI85901365	MN -11	10:23900
85-27	General Accounting Office, Document Handling and Information Services Facility, P.O. Box 6015, Gaithersburg, MD 20760	TI85901161	MN -70	10:23551
GEAP-				
25163-10	NTIS (US Sales Only), PC A17/MF A01; 1 (GPO Dep.)	E 1.99: DE85010156	STD -78	10:23781
GJ/TMC-				
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE85009789	STD -70A	10:23552
GPO-				
36-903	*See* N-85-12182			10:23921
GTFR-				
53	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85011070	MN -20f	10:24903
HNEI-				
82-02	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85011071	MN -61B	10:23621
84-02	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE85009761	MN -63	10:23644
84-S01	NTIS, PC A03/MF A01; 1	DE85901283	MN -66	10:23714
IAE-				
3556/ 13	NTIS (US Sales Only), PC A02/MF A01	DE85700880	MN -4	10:24159
3585/ 1	NTIS (US Sales Only), PC A02/MF A01	DE85700864	MN -34C	10:24745
IC-				
84/ 36	NTIS (US Sales Only), PC A04/MF A01	DE85700529	MN -34D	10:24651
84/ 37	NTIS (US Sales Only), PC A02/MF A01	DE85700473	MN -34D	10:24711
84/ 58	NTIS (US Sales Only), PC A03/MF A01	DE85700530	MN -34D	10:24652
84/ 59	NTIS (US Sales Only), PC A02/MF A01	DE85700510	MN -34A	10:24828
84/ 60	NTIS (US Sales Only), PC A02/MF A01	DE85700531	MN -34D	10:24653
84/ 72	NTIS (US Sales Only), PC A02/MF A01	DE85700520	MN -34D	10:24654
84/ 74	NTIS (US Sales Only), PC A02/MF A01	DE85700493	MN -34A	10:24829
84/ 75	NTIS (US Sales Only), PC A02/MF A01	DE85700532	MN -34D	10:24655
84/ 76	NTIS (US Sales Only), PC A02/MF A01	DE85700494	MN -34A	10:24830
84/ 79	NTIS (US Sales Only), PC A02/MF A01	DE85700474	MN -34D	10:24712
84/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700498	MN -34A	10:24831
84/ 83	NTIS (US Sales Only), PC A02/MF A01	DE85700499	MN -34A	10:24832
84/ 85	NTIS (US Sales Only), PC A02/MF A01	DE85700533	MN -34D	10:24656
84/ 89	NTIS (US Sales Only), PC A03/MF A01	DE85700521	MN -34D	10:24657
84/ 91	NTIS (US Sales Only), PC A02/MF A01	DE85700545	MN -46	10:24816
84/ 96	NTIS (US Sales Only), PC A02/MF A01	DE85700500	MN -34A	10:24833
84/ 97	NTIS (US Sales Only), PC A02/MF A01	DE85700509	MN -34A	10:24105
84/ 102	NTIS (US Sales Only), PC A02/MF A01	DE85700527	MN -34D	10:24658
84/ 108	NTIS (US Sales Only), PC A02/MF A01	DE85700471	MN -34D	10:24713
84/ 112	NTIS (US Sales Only), PC A02/MF A01	DE85700519	MN -34D	10:24659
84/ 126	NTIS (US Sales Only), PC A03/MF A01	DE85700516	MN -34A	10:24597
84/ 127	NTIS (US Sales Only), PC A02/MF A01	DE85700472	MN -34D	10:24714
84/ 135	NTIS (US Sales Only), PC A02/MF A01	DE85700544	MN -46	10:24817
84/ 145	NTIS (US Sales Only), PC A02/MF A01	DE85700528	MN -34D	10:24660

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IFRF-F-				
259/ a/ 1	International Flame Research Foundation, Ijmuiden, Netherlands		ND -38	10:24242
IFSR-				
143	*See* DOE/ET/53088-143	E 1.99: DE85010401	MN -20	10:24900
170	*See* DOE/ET/53088-170	E 1.99: DE85010114	MN -20a	10:24901
173	*See* DOE/ET/53088-173	E 1.99: DE85010084	MN -20g	10:24902
IFT-M-				
01/ 82	NTIS (US Sales Only), PC A06/MF A01	DE85700475	MN -34D	10:24715
IFT-P-				
12/ 82	*See* IFUSP-P-386	DE85700478	MN -34D	10:24719
16/ 82	*See* IFUSP-P-371	DE85700517	MN -34D	10:24661
IFUSP-P-				
340	NTIS (US Sales Only), PC A02/MF A01	DE85700463	MN -34D	10:24844
349	NTIS (US Sales Only), PC A03/MF A01	DE85700476	MN -34D	10:24716
357	NTIS (US Sales Only), PC A03/MF A01	DE85700450	MN -34D	10:24717
358	NTIS (US Sales Only), PC A04/MF A01	DE85700501	MN -34A	10:24834
359	NTIS (US Sales Only), PC A02/MF A01	DE85700451	MN -34D	10:24718
362	NTIS (US Sales Only), PC A03/MF A01	DE85700512	MN -20	10:24904
371	NTIS (US Sales Only), PC A02/MF A01	DE85700517	MN -34D	10:24661
380	NTIS (US Sales Only), PC A03/MF A01	DE85700522	MN -34D	10:24662
384	NTIS (US Sales Only), PC A03/MF A01	DE85700534	MN -34D	10:24663
385	NTIS (US Sales Only), PC A02/MF A01	DE85700477	MN -34D	10:24845
386	NTIS (US Sales Only), PC A03/MF A01	DE85700478	MN -34D	10:24719
387	NTIS (US Sales Only), PC A02/MF A01	DE85700546	MN -34C	10:24266
388	NTIS (US Sales Only), PC A03/MF A01	DE85700482	MN -34D	10:24701
391	NTIS (US Sales Only), PC A02/MF A01	DE85700452	MN -34D	10:24846
395	NTIS (US Sales Only), PC A03/MF A01	DE85700453	MN -34D	10:24847
397	NTIS (US Sales Only), PC A02/MF A01	DE85700535	MN -34D	10:24664
399	NTIS (US Sales Only), PC A02/MF A01	DE85700454	MN -34D	10:24848
402	NTIS (US Sales Only), PC A02/MF A01	DE85700483	MN -34D	10:24702
405	NTIS (US Sales Only), PC A03/MF A01	DE85700536	MN -34D	10:24720
409	NTIS (US Sales Only), PC A02/MF A01	DE85700502	MN -34A	10:24818
415	NTIS (US Sales Only), PC A02/MF A01	DE85700537	MN -34D	10:24665
421	NTIS (US Sales Only), PC A03/MF A01	DE85700455	MN -34D	10:24849
424	NTIS (US Sales Only), PC A02/MF A01	DE85700456	MN -34D	10:24850
425	NTIS (US Sales Only), PC A03/MF A01	DE85700464	MN -34D	10:24851
426	NTIS (US Sales Only), PC A02/MF A01	DE85700503	MN -34A	10:24025
427	NTIS (US Sales Only), PC A02/MF A01	DE85700457	MN -34D	10:24889
429	NTIS (US Sales Only), PC A03/MF A01	DE85700504	MN -34A	10:24106
430	NTIS (US Sales Only), PC A02/MF A01	DE85700479	MN -34D	10:24721
431	NTIS (US Sales Only), PC A02/MF A01	DE85700458	MN -34D	10:24852
432	NTIS (US Sales Only), PC A02/MF A01	DE85700459	MN -34D	10:24853
434	NTIS (US Sales Only), PC A02/MF A01	DE85700538	MN -34D	10:24666
436	NTIS (US Sales Only), PC A02/MF A01	DE85700505	MN -34A	10:24107
437	NTIS (US Sales Only), PC A03/MF A01	DE85700506	MN -34A	10:24108
439	NTIS (US Sales Only), PC A03/MF A01	DE85700460	MN -34D	10:24854
441	NTIS (US Sales Only), PC A02/MF A01	DE85700507	MN -34A	10:24026
444	NTIS (US Sales Only), PC A02/MF A01	DE85700480	MN -34D	10:24722
445	NTIS (US Sales Only), PC A02/MF A01	DE85700461	MN -34D	10:24855
446	NTIS (US Sales Only), PC A02/MF A01	DE85700539	MN -34D	10:24667
449	NTIS (US Sales Only), PC A02/MF A01	DE85700508	MN -34A	10:24109
450-Rev.	NTIS (US Sales Only), PC A02/MF A01	DE85700800	MN -34D	10:24856
IFVE-OEF-				
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83-124	NTIS (US Sales Only), PC A02/MF A01	DE85700847	MN -34D	10:24668
83-155	NTIS (US Sales Only), PC A02/MF A01	DE85700855	MN -34D	10:24616
IFVE-OEIPK-				
83-153	NTIS (US Sales Only), PC A03/MF A01	DE85700857	MN -34D	10:24617
IFVE-OTF-				
83-117	NTIS (US Sales Only), PC A02/MF A01	DE85700804	MN -34D	10:24723
83-141	NTIS (US Sales Only), PC A02/MF A01	DE85700790	MN -34D	10:24857
83-146	NTIS (US Sales Only), PC A02/MF A01	DE85700805	MN -34D	10:24724
IMG-TNO-G-				
1236	Instituut voor Milieuhygiene en Gezondheidstechniek TNO, Delft, Netherlands		ND -11	10:24293
INDC(FR)-				
62/ L	*See* CEA-N-2396	DE85901311	MN -34C	10:24742
INIS-BR-				
150	NTIS (US Sales Only), PC A02/MF A01	DE85780820	MN -34D	10:24669
151	NTIS (US Sales Only), PC A03/MF A01	DE85780836	MN -34D	10:24670
152	NTIS (US Sales Only), PC A02/MF A01	DE85780818	MN -34D	10:24858
153	NTIS (US Sales Only), PC A03/MF A01	DE85780844	MN -4	10:24146
154	NTIS (US Sales Only), PC A02/MF A01	DE85780854	MN -23	10:24404
155	NTIS (US Sales Only), PC A02/MF A01	DE85780852	MN -51	10:24471
156	NTIS (US Sales Only), PC A11/MF A01	DE85780829	MN -20	10:24705
157	NTIS (US Sales Only), PC A06/MF A01	DE85780841	MN -34C	10:24766
158	NTIS (US Sales Only), PC A06/MF A01	DE85780838	MN -46	10:24258
159	NTIS (US Sales Only), PC A02/MF A01	DE85780855	MN -41	10:24397
INIS-mf-				
9251	NTIS (US Sales Only), PC A04/MF A01	DE85780821	MN -34D	10:24725
9261	NTIS (US Sales Only), PC A03/MF A01	DE85780822	MN -34D	10:24726
9262	NTIS (US Sales Only), PC A04/MF A01	DE85780834	MN -34D	10:24671
9263	NTIS (US Sales Only), PC A21/MF A01	DE85780864	MN -77	10:23806

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
9264	NTIS (US Sales Only), PC A07/MF A01	DE85780837	MN -34D	10:24618
9265	NTIS (US Sales Only), PC A06/MF A01	DE85780842	MN -34C	10:24786
9267	NTIS (US Sales Only), PC A09/MF A01	DE85780849	MN -4	10:23553
9268	NTIS (US Sales Only), PC A07/MF A01	DE85780840	MN -34C	10:24768
9269	NTIS (US Sales Only), PC A06/MF A01	DE85780839	MN -34C	10:24751
9270	NTIS (US Sales Only), PC A08/MF A01	DE85780863	MN -78	10:23853
9271	NTIS (US Sales Only), PC A08/MF A01	DE85780860	MN -28	10:24259
9272	NTIS (US Sales Only), PC A08/MF A01	DE85780861	MN -28	10:24260
9275	NTIS (US Sales Only), PC A04/MF A01	DE85780845	MN -4	10:24160
9276	NTIS (US Sales Only), PC A04/MF A01	DE85780846	MN -4	10:24186
9277	NTIS (US Sales Only), PC A04/MF A01	DE85780847	MN -4	10:24187
9278	NTIS (US Sales Only), PC A05/MF A01	DE85780843	MN -34C	10:24787
9279	NTIS (US Sales Only), PC A07/MF A01	DE85780823	MN -34A	10:24549
9281	NTIS (US Sales Only), PC A04/MF A01	DE85780848	MN -4	10:24188
9282	NTIS (US Sales Only), PC A06/MF A01	DE85780856	MN -48	10:24398
9446	NTIS (US Sales Only), PC A04/MF A01	DE85780868	MN -2	10:23905
9490	NTIS (US Sales Only), PC A05/MF A01	DE85780851	MN -51	10:23514
9491	NTIS (US Sales Only), PC A09/MF A01	DE85780866	MN -70	10:23554
9492	NTIS (US Sales Only), PC A03/MF A01	DE85780865	MN -70	10:23555
9493	NTIS (US Sales Only), PC A04/MF A01	DE85780850	MN -86	10:23517
9494	NTIS (US Sales Only), PC A03/MF A01	DE85780853	MN -51	10:23534
9495	NTIS (US Sales Only), PC A07/MF A01	DE85780857	MN -28	10:24261
9496	NTIS (US Sales Only), PC A03/MF A01	DE85780867	MN -2	10:23795
9497	NTIS (US Sales Only), PC A06/MF A01	DE85780859	MN -28	10:24262
9498	NTIS (US Sales Only), PC A04/MF A01	DE85780858	MN -28	10:24743
9499	NTIS (US Sales Only), PC A02/MF A01	DE85780862	MN -25	10:24234
9500	NTIS (US Sales Only), PC A09/MF A01	DE85780832	MN -34A	10:24598
9501	NTIS (US Sales Only), PC A08/MF A01	DE85780833	MN -34A	10:24027
9503	NTIS (US Sales Only), PC A05/MF A01	DE85780830	MN -20	10:24906
9504	NTIS (US Sales Only), PC A07/MF A01	DE85780819	MN -34D	10:24859
9505	NTIS (US Sales Only), PC A09/MF A01	DE85780825	MN -34A	10:24147
9506	NTIS (US Sales Only), PC A09/MF A01	DE85780826	MN -34A	10:24550
9507	NTIS (US Sales Only), PC A09/MF A01	DE85780828	MN -34A	10:24551
9508	NTIS (US Sales Only), PC A06/MF A01	DE85780831	MN -20	10:24907
9509	NTIS (US Sales Only), PC A06/MF A01	DE85780827	MN -34A	10:24087
9510	NTIS (US Sales Only), PC A08/MF A01	DE85780824	MN -34A	10:24162
9511	NTIS (US Sales Only), PC A08/MF A01	DE85780835	MN -34D	10:24672
INPE-				
2567	NTIS (US Sales Only), PC A02/MF A01	DE85700514	MN -34B	10:24290
2672	NTIS (US Sales Only), PC A02/MF A01	DE85700515	MN -34B	10:24482
INS-				
477	NTIS (US Sales Only), PC A02/MF A01	DE85700801	MN -34D	10:24860
478	NTIS (US Sales Only), PC A05/MF A01	DE85700869	MN -34C	10:24754
480	NTIS (US Sales Only), PC A02/MF A01	DE85700853	MN -34D	10:24673
481	NTIS (US Sales Only), PC A03/MF A01	DE85700848	MN -34D	10:24674
482	NTIS (US Sales Only), PC A02/MF A01	DE85700874	MN -34C	10:24797
INS-NUMA-				
44	NTIS (US Sales Only), PC A09/MF A01	DE85780870	MN -34D	10:24788
INS-TS-				
22	NTIS (US Sales Only), PC A04/MF A01	DE85700873	MN -34C	10:23589
IPPJ-				
632	NTIS (US Sales Only), PC A08/MF A01	DE85780869	MN -20	10:24921
641	NTIS (US Sales Only), PC A04/MF A01	DE85700791	MN -34D	10:24861
ITEF-				
13(1983)	NTIS (US Sales Only), PC A03/MF A01	DE85700785	MN -34D	10:24862
57(1983)	NTIS (US Sales Only), PC A02/MF A01	DE85700819	MN -34A	10:24552
66(1983)	NTIS (US Sales Only), PC A02/MF A01	DE85700836	MN -20	10:25039
94(1983)	NTIS (US Sales Only), PC A02/MF A01	DE85700786	MN -34D	10:24863
119(1983)	NTIS (US Sales Only), PC A04/MF A01	DE85700813	MN -34D	10:24703
124(1983)	NTIS (US Sales Only), PC A03/MF A01	DE85700870	MN -34C	10:24803
136(1983)	NTIS (US Sales Only), PC A02/MF A01	DE85700792	MN -34D	10:24727
189(1983)	NTIS (US Sales Only), PC A02/MF A01	DE85700875	MN -34C	10:24771
ITEP-				
28(1983)	NTIS (US Sales Only), PC A03/MF A01	DE85700843	MN -34D	10:24675
76(1983)	NTIS (US Sales Only), PC A02/MF A01	DE85700807	MN -34D	10:24728
167(1983)	NTIS (US Sales Only), PC A02/MF A01	DE85700806	MN -34D	10:24729
179(1983)	NTIS (US Sales Only), PC A03/MF A01	DE85700793	MN -34D	10:24864
IVL-B-				
745	NTIS (US Sales Only), PC A06/MF A01	DE85751457	MN -11	10:24320
761	NTIS (US Sales Only), PC A04/MF A01; 1	DE85751458	MN -95	10:24243
JAERI-				
1288	NTIS (US Sales Only), PC A03/MF A01	DE85700902	MN -41	10:24405
JAERI-M-				
83-134	NTIS (US Sales Only), PC A11/MF A01	DE85700900	MN -41	10:24824
83-138	NTIS (US Sales Only), PC A07/MF A01	DE85700885	MN -25	10:24028
83-143	NTIS (US Sales Only), PC A06/MF A01	DE85700821	MN -34A	10:24553
83-155	NTIS (US Sales Only), PC A04/MF A01	DE85700815	MN -34A	10:24554
83-156	NTIS (US Sales Only), PC A03/MF A01	DE85700901	MN -41	10:24406
83-164	NTIS (US Sales Only), PC A03/MF A01	DE85700816	MN -34A	10:24555
83-178	NTIS (US Sales Only), PC A02/MF A01	DE85700888	MN -25	10:24110
83-198	NTIS (US Sales Only), PC A03/MF A01	DE85700817	MN -34A	10:24556
83-201	NTIS (US Sales Only), PC A03/MF A01	DE85700892	MN -34B	10:24304
83-203	NTIS (US Sales Only), PC A02/MF A01	DE85700889	MN -25	10:23794
83-209	NTIS (US Sales Only), PC A02/MF A01	DE85700882	MN -86	10:23526

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1-83-847	NTIS (US Sales Only), PC A02/MF A01		DE85700837	MN -34B	10:24486
1-83-912	NTIS (US Sales Only), PC A02/MF A01		DE85700859	MN -34D	10:24619
14-84-69	NTIS (US Sales Only), PC A02/MF A01		DE85700824	MN -34A	10:24111
19-83-845	NTIS (US Sales Only), PC A02/MF A01		DE85700896	MN -48	10:24407
E-2-83-921	NTIS (US Sales Only), PC A02/MF A01		DE85700849	MN -34D	10:24676
E-2-84-21	NTIS (US Sales Only), PC A02/MF A01		DE85700787	MN -34D	10:24865
E-2-84-49	NTIS (US Sales Only), PC A02/MF A01		DE85700796	MN -34D	10:24866
E-2-84-51	NTIS (US Sales Only), PC A02/MF A01		DE85700797	MN -34D	10:24867
E-4-84-27	NTIS (US Sales Only), PC A02/MF A01		DE85700865	MN -34C	10:24804
E-17-83-874	NTIS (US Sales Only), PC A02/MF A01		DE85700794	MN -34D	10:24868
E-17-84-22	NTIS (US Sales Only), PC A02/MF A01		DE85700795	MN -34D	10:24869
R-2-83-843	NTIS (US Sales Only), PC A02/MF A01		DE85700808	MN -34D	10:24730
R-2-83-897	NTIS (US Sales Only), PC A02/MF A01		DE85700802	MN -34D	10:24870
R-2-84-71	NTIS (US Sales Only), PC A02/MF A01		DE85700803	MN -34D	10:24871
R-2-84-97	NTIS (US Sales Only), PC A02/MF A01		DE85700811	MN -34D	10:24731
R-2-84-114	NTIS (US Sales Only), PC A02/MF A01		DE85700867	MN -34C	10:24805
R-2-84-163	NTIS (US Sales Only), PC A02/MF A01		DE85700850	MN -34D	10:24677
R-2-84-211	NTIS (US Sales Only), PC A02/MF A01		DE85700798	MN -34D	10:24872
R-4-84-28	NTIS (US Sales Only), PC A02/MF A01		DE85700799	MN -34D	10:24873
R-4-84-151	NTIS (US Sales Only), PC A02/MF A01		DE85700866	MN -34C	10:24778
R-7-83-57	NTIS (US Sales Only), PC A02/MF A01		DE85700818	MN -34A	10:24557
JINR-D-					
1-83-865	NTIS (US Sales Only), PC A02/MF A01		DE85700543	MN -34D	10:24620
JINR-R-					
1-84-79	NTIS (US Sales Only), PC A02/MF A01		DE85700858	MN -34D	10:24621
2-83-438	NTIS (US Sales Only), PC A02/MF A01		DE85700844	MN -34D	10:24678
2-83-507	NTIS (US Sales Only), PC A02/MF A01		DE85700845	MN -34D	10:24679
2-84-5	NTIS (US Sales Only), PC A02/MF A01		DE85700851	MN -34D	10:24680
2-84-40	NTIS (US Sales Only), PC A02/MF A01		DE85700846	MN -34D	10:24681
2-84-63	NTIS (US Sales Only), PC A02/MF A01		DE85700810	MN -34D	10:24732
2-84-109	NTIS (US Sales Only), PC A03/MF A01		DE85700809	MN -34D	10:24733
5-84-75	NTIS (US Sales Only), PC A02/MF A01		DE85700788	MN -34D	10:24874
7-83-627	NTIS (US Sales Only), PC A02/MF A01		DE85700830	MN -34A	10:24558
7-83-667	NTIS (US Sales Only), PC A02/MF A01		DE85700876	MN -34C	10:24789
JPL-PUB-					
84-14	*See* N-85-13245				10:23998
K/CSD/TM-					
49	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010701	MN -32	10:25076
KEK-					
83-6	NTIS (US Sales Only), PC A06/MF A01		DE85700863	MN -34C	10:24806
83-15	NTIS (US Sales Only), PC A04/MF A01		DE85700854	MN -34D	10:24623
83-18	NTIS (US Sales Only), PC A02/MF A01		DE85700887	MN -25	10:24029
KFTI-					
83-16	NTIS (US Sales Only), PC A03/MF A01		DE85700832	MN -20	10:24922
83-21	NTIS (US Sales Only), PC A02/MF A01		DE85700835	MN -20	10:24923
83-29	NTIS (US Sales Only), PC A03/MF A01		DE85700834	MN -20	10:24924
83-33	NTIS (US Sales Only), PC A02/MF A01		DE85700831	MN -34A	10:24559
KGI-					
064	NTIS (US Sales Only), PC A02/MF A01		DE85700894	MN -34B	10:24487
KHM-TR-					
48	NTIS (US Sales Only), PC A07/MF A01; 1		DE85751417	MN -90	10:23419
67	NTIS (US Sales Only), PC A04; 3		DE85751418	MN -90i	10:23466
84	NTIS (US Sales Only), PC A06/MF A01; 1		DE85751419	MN -90i	10:23420
KMU-HEP-					
83-10	NTIS (US Sales Only), PC A02/MF A01		DE85700481	MN -34D	10:24734
84-01	NTIS (US Sales Only), PC A02/MF A01		DE85700484	MN -34D	10:24735
KTR-					
84-19-Pt.1	*See* STEV-BF-84-16-Pt.1		DE85751456	MN -61D	10:23592
LA-					
9985-MS	*See* NUREG/CR-4111		TI85010353	MN -41	10:24203
10243-MS	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85010332	STD -15	10:23583
10245-MS	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010334	STD -92b	10:23996
10248-MS	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010323	STD -34C	10:24807
10271-PR	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010333	STD -80	10:23808
10306-MS	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010344	STD -15	10:23584
10321-MS	*See* NUREG/CR-4109	E 1.99:	TI85010227	MN -78	10:23868
10338-T	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010355	STD -34C	10:24756
10347-HDR	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85010570	STD -66b	10:23715
10354-MS	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010571	STD -32	10:25077
10374-PR	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010356	STD -92	10:23492
10380	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010330	STD -21	10:25040
LA-UR-					
82-2268	NTIS, PC A05; 3		DE85011051	MN -38	10:24218
85-513-Rev.	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009585	MN -20d	10:25041
85-747	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009589	MN -21	10:25042
85-748	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009590	MN -21	10:25043
85-783	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009594	MN -37	10:24267
85-790	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009571	MN -21	10:25044
85-883	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009548	MN -28	10:24219
85-982	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE85009635	MN -20d	10:25045
85-1028	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009621	MN -37	10:24276
85-1060	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009627	MN -34	10:24704
85-1062	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009628	MN -25	10:24001

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85-1097	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009603	MN -4	10:24180
85-1133	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009610	MN -28	10:24252
LALP-					
84-60	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010383	MN -11	10:24246
LBL-					
17074	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85004441	STD -95d	10:23964
17530	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009939	MN -25	10:24112
17552	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009959	MN -25	10:24277
17591	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009943	MN -95d	10:23979
17774	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009957	MN -95d	10:23965
17780	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009944	MN -37	10:24268
18025	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009960	MN -95d	10:23966
18062	NTIS, PC A02/MF A01		DE84016877	MN -95d	10:23967
18188	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010629	STD -95c	10:24294
18232	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE85010644	MN -66a	10:23700
18281	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009940	MN -93A	10:23940
18299	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010630	STD -95d	10:23968
18393	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010638	STD -48	10:24408
18451	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE85010636	STD -70	10:23556
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332	NTIS (US Sales Only), PC A08/MF A01; 1		DE85751454	MN -97b	10:23927
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NASA-TM-					
77505	*See* N-85-12332				10:24278
85792	NTIS, PC A03/MF A01		TI85901297	MN -38	10:24279
86878	*See* N-85-12095				10:23997
86950	*See* DOE/NASA/20320-62	E 1.99:	DE85010012	STD -60	10:23724
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2277	*See* N-84-20759		DE85900884	MN -94c	10:23883
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3-42-Rev.3-84	Nuclear Standards Management Center, P.O. Box Y, Oak Ridge, TN 37831		TI85009459	ND -11	10:24200
3-43-Amend.3-85	Nuclear Standard Management Center, P.O. Box Y, Oak Ridge, TN 37831		TI85009460	ND -11	10:24201
3-45T-Rev.3-85	Nuclear Standards Management Center, P.O. Box Y, Oak Ridge, TN 37831		TI85009461	ND -11	10:24207
9-2T-Rev.(2-85)	Nuclear Standards Managment Center, P.O. Box Y, Oak Ridge, TN 37831		TI85010031	ND -79T	10:23871
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83055-U	Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands			ND -60	10:23733
84001-U	Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands			ND -38	10:24202
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4901631	NTIS (US Sales Only), PC A03/MF A01		DE84901631	MN -90j	10:24114
5770233	NTIS (US Sales Only), PC A03/MF A01; 1		DE85770233	MN -38	10:24195
5770234	NTIS (US Sales Only), PC A02/MF A01; 1		DE85770234	MN -95e	10:23987
5770235	NTIS (US Sales Only), PC A02/MF A01; 1		DE85770235	MN -13	10:23919
5770254	NTIS (US Sales Only), PC A09/MF A01; 1		DE85770254	MN -95	10:23988
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5901293	NTIS, PC A07/MF A01; 1		DE85901293	MN -98A	10:23425
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0847-Suppl.4	NTIS, PC A03/MF A01 - GPO $4.00		TI85901262	MN -78	10:23856
0887-Suppl.6	NTIS, PC A07/MF A01 - GPO $5.50		TI85901343	MN -78	10:23857
1065-Rev.1	NTIS, PC A04/MF A01 - GPO $4.50		TI85901312	MN -15	10:23585
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3193	NTIS PC E16/MF A01 - GPO		TI85009331	MN -78	10:24229
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3804-Vol.4	NTIS, PC A02/MF A01 - GPO		TI85009875	MN -79p	10:23862
3816-2	NTIS, PC A10/MF A01 - GPO		TI85009655	MN -80	10:23863
3820-Vol.3	NTIS, PC A05/MF A01 - GPO		TI85010514	MN -78	10:23864
3930	NTIS, PC A04/MF A01 - GPO		TI85007728	MN -78	10:23865
4064	NTIS, PC A06/MF A01 - GPO		TI85010460	MN -78	10:23866
4070-Vol.3	NTIS, PC A04/MF A01 - GPO $4.50		TI85010466	MN -80	10:23812
4090	NTIS, PC A06 - GPO $5.00		DE85900604	MN -80	10:23867
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4170	NTIS, PC A03/MF A01 - GPO $3.75		TI85901284	MN -80	10:23813
4198	NTIS, PC A05/MF A01 - GPO $4.50		TI85901319	MN -70	10:24115
4226	NTIS, PC A07/MF A01 - GPO $5.50		TI85901376	MN -11	10:24468
NYSERDA-					
84-5	*See* N-85-13068				10:23595
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85-0004	OCS Information Program, Minerals Management Service, 12203 Sunrise Valley Dr., MS 640 Reston, VA 22091		TI85901335	MN -92	10:23480
OFR-					
192-80	*See* PB-85-145902/AS		TI85901320	MN -51	10:23515
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241	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009955	MN -41	10:24330
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6139	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85010585	STD -4	10:24149
6140	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99:	DE85010452	STD -11	10:24296
6143	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009818	MN -41	10:24270
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84/ 8	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85010450	STD -20d	10:25047
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81-00070	NTIS (US Sales Only), PC A02/MF A01		DE84901591	MN -25	10:24116
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84-911503	*See* DOE/NE-0048/8	E 1.99:	DE85010433	STD -80	10:23774
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831-82-01	NTIS (US Sales Only), PC A09/MF A01		DE85780801	MN -34C	10:23524
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13/ 82	NTIS (US Sales Only), PC A02/MF A01		DE85700486	MN -34A	10:24562
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83-15	NTIS (US Sales Only), PC A02/MF A01		DE85700814	MN -34D	10:24737
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83-7019	NTIS, PC A12/MF A01 (GPO Dep.)	E 1.99:	DE85011179	MN -63a	10:23645
83-8019	NTIS, PC A09/MF A01 (GPO Dep.)	E 1.99:	DE85009113	MN -62	10:23648
84-0288	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE84010626	MN -66b	10:23716
84-0627C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008405	MN -62b	10:23633
84-0646	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010574	STD -70	10:23581
84-1025/ 3	*See* NUREG/CR-3820-Vol.3		TI85010514	MN -78	10:23864
84-1072-2	*See* NUREG/CR-3816-2		TI85009655	MN -80	10:23863
84-1287	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85011146	MN -60	10:23734
84-1471	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009301	MN -70	10:23566
84-1507	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010532	MN -13	10:24289
84-1520	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009991	MN -78	10:24274
84-1637	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85008394	MN -38	10:24235
84-1643	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE85011180	MN -70	10:23567
84-1694	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008699	STD -63a	10:23634
84-1956C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007608	MN -4	10:24181
84-1974C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010072	MN -45	10:24287
84-2002C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010120	MN -63	10:23635
84-2016C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010070	MN -34A	10:24222
84-2034	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85008876	MN -20c	10:25051
84-2087	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010828	STD -70	10:23582

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
84-2146	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008481	MN -25	10:24032
84-2245	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85011080	MN -28	10:25052
84-2308C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010091	MN -25	10:24119
84-2322	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010534	MN -32	10:24280
84-2365C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010092	MN -25	10:24120
84-2375C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010094	MN -25	10:24100
84-7025	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010013	MN -63c	10:23636
84-7177	*See* NUREG/CR-4064		TI85010460	MN -78	10:23866
84-8186	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010033	MN -62a	10:23649
84-8710	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010027	MN -25	10:24033
85-0050C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009759	MN -70	10:23568
85-0101	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85010416	STD -90	10:23395
85-0108	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010533	MN -32	10:25078
85-0312	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010411	MN -92	10:23504
85-0494C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009436	MN -28	10:24248
85-0545C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009409	MN -38	10:24244
85-0556C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009837	MN -62b	10:23678
85-0884C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009712	MN -80	10:23870
85-0946C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010389	MN -63	10:23637
85-0951C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010119	MN -63	10:23638
85-8176	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010831	MN -62a	10:23693
85-8206	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010830	MN -62a	10:23694
SERI/PR-					
211-2468	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85002943	MN -63	10:23639
215-2526	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009615	MN -58e	10:23610
SERI/STR-					
217-2559	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE85002948	MN -60	10:23735
SERI/TP-					
251-2671	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85000514	MN -62c	10:23650
252-2569	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85000534	MN -62a	10:23697
253-2672	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85000516	MN -59A	10:23679
255-2001	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009873	MN -62	10:23651
SERI/TR-					
211-2480	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85002946	MN -63	10:24121
231-2593	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85002936	MN -62	10:23698
635-1166	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE85002947	MN -60	10:23721
642-1156	NTIS, PC A18/MF A01; 1 (GPO Dep.)	E 1.99:	DE85000082	MN -59A	10:23611
SIND-PM-					
1983-9	NTIS (US Sales Only), PC A08/MF A01; 1		DE85751471	MN -61A	10:23597
SKBF-KBS-TR-					
83-74	NTIS (US Sales Only), PC A04/MF A01		DE85700891	MN -51	10:24458
SKI-B-					
24-80	NTIS (US Sales Only), PC A02/MF A01		DE85700886	MN -25	10:24034
SLAC-PUB-					
3537	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008179	MN -34D	10:24687
3572	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009846	MN -28	10:24254
3589	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010537	MN -34D	10:24625
3601	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010538	MN -28	10:24255
3629	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010536	MN -28	10:24249
SLU-IVL-					
142	NTIS (US Sales Only), PC A05/MF A01; 1		DE85751408	MN -61D	10:23598
SLU-IVL-U-					
130	NTIS (US Sales Only), PC A03/MF A01; 1		DE85751409	MN -61D	10:23599
SMHI-MK-					
1984-19	*See* STEV-VIND-84-23		DE85751416	MN -60	10:23718
SNV-PM-					
1773	NTIS (US Sales Only), PC A04/MF A01		DE85751412	MN -11	10:24417
1815	NTIS (US Sales Only), PC A06/MF A01; 1		DE85751445	MN -11	10:24327
1819	NTIS (US Sales Only), PC A04/MF A01		DE85751414	MN -11	10:24310
SOL-					
85-3	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85010616	MN -32	10:25079
SSI-K-					
82-08	NTIS (US Sales Only), PC A02/MF A01		DE85700893	MN -34B	10:24307
STEV-BF-					
84-16-Pt.1	NTIS (US Sales Only), PC A13/MF A01; 1		DE85751456	MN -61D	10:23592
STEV-EO-					
84-1	NTIS (US Sales Only), PC A09/MF A01; 1		DE85751410	MN -61A	10:23640
84-6	NTIS (US Sales Only), PC A05/MF A01; 1		DE85751437	MN -61D	10:23600
STEV-FBA-					
83-21	NTIS (US Sales Only), PC A05/MF A01; 1		DE85751411	MN -61D	10:23461
84-8	NTIS (US Sales Only), PC A04/MF A01; 1		DE85751429	MN -38	10:24245
84-21	NTIS (US Sales Only), PC A03/MF A01		DE85751441	MN -90e	10:23462
STEV-SB-					
84-15	NTIS (US Sales Only), PC A03/MF A01		DE85751460	MN -61D	10:23601
STEV-TFS-					
84-4	NTIS (US Sales Only), PC A08/MF A01; 1		DE85751413	MN -97	10:23929
84-5	NTIS (US Sales Only), PC A08/MF A01; 1		DE85751415	MN -98	10:23910
STEV-TORV-					
83-4	NTIS (US Sales Only), PC A03/MF A01; 1		DE85751420	MN -89	10:23438
84-12	NTIS (US Sales Only), PC A02/MF A01		DE85751442	MN -90	10:23396
84-13	NTIS (US Sales Only), PC A03/MF A01; 1		DE85751461	MN -90e	10:23463
STEV-VIND-					
83-32	NTIS (US Sales Only), PC A02; 3		DE85751436	MN -60	10:23736
83-33	NTIS (US Sales Only), PC A03/MF A01; 1		DE85751435	MN -60	10:23737

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
84-23	NTIS (US Sales Only), PC A03/MF A01; 1		DE85751416	MN -60	10:23718
84-31	NTIS (US Sales Only), PC A02/MF A01		DE85751440	MN -60	10:23738
84-32	NTIS (US Sales Only), PC A02/MF A01		DE85751439	MN -60	10:23739
84-33	NTIS (US Sales Only), PC A05/MF A01; 1		DE85751443	MN -60	10:23719
84-34	NTIS (US Sales Only), PC A04/MF A01; 1		DE85751444	MN -60	10:23722
84-36	NTIS (US Sales Only), PC A07/MF A01		DE85751459	MN -60	10:23740
STU-					
81-5352	*See* LITH-IKP-R-332		DE85751454	MN -97b	10:23927
STUDSVIK-EB-					
83-119	*See* STEV-FBA-84-8		DE85751429	MN -38	10:24245
SUNI-					
56	NTIS (US Sales Only), PC A06/MF A01		DE85700878	MN -4	10:24151
SV-BKM-					
103-2	NTIS (US Sales Only), PC A05/MF A01		DE85751431	MN -92	10:23498
105-2	NTIS (US Sales Only), PC A03/MF A01		DE85751432	MN -92	10:23499
SV-BVM-					
115-2	NTIS (US Sales Only), PC A03/MF A01		DE85751433	MN -92	10:23500
TI-					
84-901639	*See* N-85-13068				10:23595
TNO-HMT-R-					
84-76	Nijverheidsorganisatie TNO, Delft, Netherlands			ND -90i	10:23397
TNO-KRI-					
201-83-Pt.3	Plastics and Rubber Research Institute TNO, Delft, Netherlands			ND -90b	10:23439
201-83(Pts.1,2)	Plastics and Rubber Research Institute TNO, Delft, Netherlands			ND -90b	10:23440
TR-					
126	*See* DOE/RA/50276-T3	E 1.99:	DE85009347	MN -97	10:23743
154	*See* DOE/RA/50276-T2	E 1.99:	DE85009544	MN -97	10:23742
TRITA-EPP-					
83-08	NTIS (US Sales Only), PC A02/MF A01		DE85700833	MN -20	10:24927
84-02	NTIS (US Sales Only), PC A04/MF A01		DE85700838	MN -34B	10:24534
84-06	NTIS (US Sales Only), PC A03/MF A01		DE85700895	MN -34B	10:24543
TTC-					
0535	*See* PNL-5384	E 1.99:	DE85010214	MN -71	10:23531
TVA/OP/EDT-					
84/ 41-Vol.1	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE85009036	MN -98E	10:23741
TVA/PE/FHP-					
85/ 4	NTIS, PC A02/MF A01		DE85901206	MN -90i	10:23422
TVA/PUB-					
84/ 21a	NTIS, PC A24/MF A01; 1 (GPO Dep.)	E 1.99:	DE84007682	MN -97e	10:23606
84/ 21b	NTIS, PC A99/MF A01; 1 (GPO Dep.)	E 1.99:	DE84008049	MN -97e	10:23605
84/ 21c	NTIS, PC A20/MF A01; 1 (GPO Dep.)	E 1.99:	DE84007687	MN -97e	10:23607
85/ 20	NTIS, PC A02/MF A01; 1		DE85901316	MN -78	10:23792
85/ 21	NTIS, PC A02/MF A01		DE85901315	MN -80	10:23814
UCID-					
19993-84	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE85010407	MN -11	10:24429
20226	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010624	MN -16	10:23586
20307	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85008878	MN -94c	10:23884
20329	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85009987	MN -25	10:24035
20345	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85007337	MN -32	10:25080
20355-85-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010044	MN -25	10:24002
20374	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE85010833	MN -20	10:25053
20388	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99:	DE85009989	MN -11	10:24298
20389	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010029	MN -25	10:24204
20394	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010409	MN -38	10:24205
20403	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010836	MN -20d	10:25054
20406	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010835	MN -34B	10:24599
UCRL-					
53558	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85010449	STD -70	10:24473
53602	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010448	STD -70	10:24474
53604	NTIS, PC A15/MF A01 (GPO Dep.)	E 1.99:	DE85010773	MN -21	10:25055
53613	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010213	STD -23	10:24236
53623	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010329	STD -21	10:25056
90617	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010042	MN -20d	10:25057
91609	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008955	MN -37	10:24206
91646	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010002	MN -21	10:25058
91648	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010001	MN -21	10:25059
91740	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009449	MN -70	10:23569
91779	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010041	MN -25	10:24036
91876	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009999	MN -20f	10:25060
92019	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010180	MN -20a	10:25061
92020	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009998	MN -20d	10:25062
92021	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85009997	MN -20d	10:25063
92022	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010046	MN -20a	10:25064
92023	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010045	MN -20	10:25065
92098	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010043	MN -20d	10:25066
92289	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85008958	MN -34A	10:24037
92336	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE85009858	MN -34A	10:24223
92344	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85008966	MN -21	10:25067
92360	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010036	MN -32	10:25081
92371	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE85010003	MN -20f	10:25068
92420	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE85010038	MN -45	10:24288

Report Number	*Availability Source*	*File Number*	*Distribution Category*	*Abstract Number*
UFRJ-IF-				
01/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700541	MN -34D	10:24688
02/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700465	MN -34D	10:24738
03/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700542	MN -34D	10:24689
04/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700524	MN -34D	10:24690
05/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700525	MN -34D	10:24691
06/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700526	MN -34D	10:24692
07/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700547	MN -34C	10:24271
08/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700466	MN -34D	10:24739
09/ 82	NTIS (US Sales Only), PC A02/MF A01	DE85700467	MN -34D	10:24740
UNI-SA-				
135	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85008435	MN -80	10:23803
USGS-CIRC-				
889	Geological Survey, 604 South Pickett St., Alexandria, VA 22304	TI85900471	MN -11	10:24477
904-A	US Geological Survey, 604 S. Pickett St., Alexandria, VA 22304	TI85901310	MN -70	10:23570
USGS-OFR-				
79-306	US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901274	MN -88	10:23426
81-540	US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901330	MN -88	10:23427
81-918	US Geological Survey, Box 25245, Denver Federal Center, Denver, CO 80225	TI85901286	MN -66a	10:23704
83-428A	US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901337	MN -66	10:23710
83-431A	US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225	TI85900474	MN -66	10:23705
83-433A	US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901252	MN -66	10:23706
83-436	US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901334	MN -66	10:23707
83-440	US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901336	MN -66	10:23711
83-520	US Geological Survey Open File Services, Box 25245, Denver Federal Center, Denver, CO 80225	TI85901329	MN -92a	10:24475
83-570	US Geological Survey, Box 25245, Denver Federal Center, Denver, CO 80225	TI85901328	MN -92b	10:23485
83-576	US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901338	MN -11	10:24469
83-592	US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901285	MN -92a	10:24470
83-627	US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901344	MN -92	10:23469
83-668	US Geological Survey, Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901333	MN -11	10:24459
84-287	US Geological Survey, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901331	MN -66a	10:23708
USGS-TR-				
42	New Mexico State Engineer Office, Bataan Memorial Bldg., Santa Fe, NM 87503	TI85901214	MN -11	10:24460
USGS/WRI-				
82-4009	US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901339	MN -88	10:23428
82-4099	US Geological Survey, Box 25425, Federal Center, Denver, CO 80225	TI85901273	MN -11	10:23423
82-4111	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE85010117	MN -70	10:23571
83-4069	US Geological Survey, Box 25425, Federal Center, Denver, CO 80225	TI85901307	MN -88	10:23429
USGS/WRI/OFR-				
81-913	US Geological Survey Open File Services, Box 25425, Denver Federal Center, Denver, CO 80225	TI85901362	MN -88	10:23430
UUIP-				
1090	NTIS (US Sales Only), PC A05/MF A01	DE85700871	MN -34C	10:24748
1103	NTIS (US Sales Only), PC A02/MF A01	DE85700872	MN -34C	10:24749
1115	NTIS (US Sales Only), PC A02/MF A01	DE85700825	MN -34A	10:24038
1116	NTIS (US Sales Only), PC A02/MF A01	DE85700826	MN -34A	10:24039
1117	NTIS (US Sales Only), PC A02/MF A01	DE85700827	MN -34A	10:24040
1118	NTIS (US Sales Only), PC A02/MF A01	DE85700828	MN -34A	10:24041
1119	NTIS (US Sales Only), PC A02/MF A01	DE85700829	MN -34A	10:24042
UVA-ER-				
953-84U	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE85009021	MN -22	10:23522
UWThPh-				
84-37	NTIS (US Sales Only), PC A02/MF A01	DE85700468	MN -34D	10:24876
84-38	NTIS (US Sales Only), PC A02/MF A01	DE85700469	MN -34D	10:24877
84-39	NTIS (US Sales Only), PC A02/MF A01	DE85700518	MN -34D	10:24693
VPI-E-				
80.23	*See* NBS-GCR-84-459	DE85901216	MN -59A	10:23691
VTT-TUTK-				
28	NTIS (US Sales Only), PC A08/MF A01; 1	DE85751474	MN -95d	10:23974
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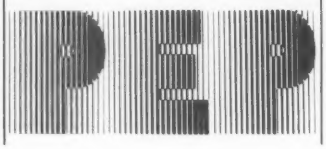

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